



OFFICIAL JOURNAL
OF THE
COMMUNITY ANTENNA
TELEVISION ASSOCIATION

September
1979

CATJ



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Session I...

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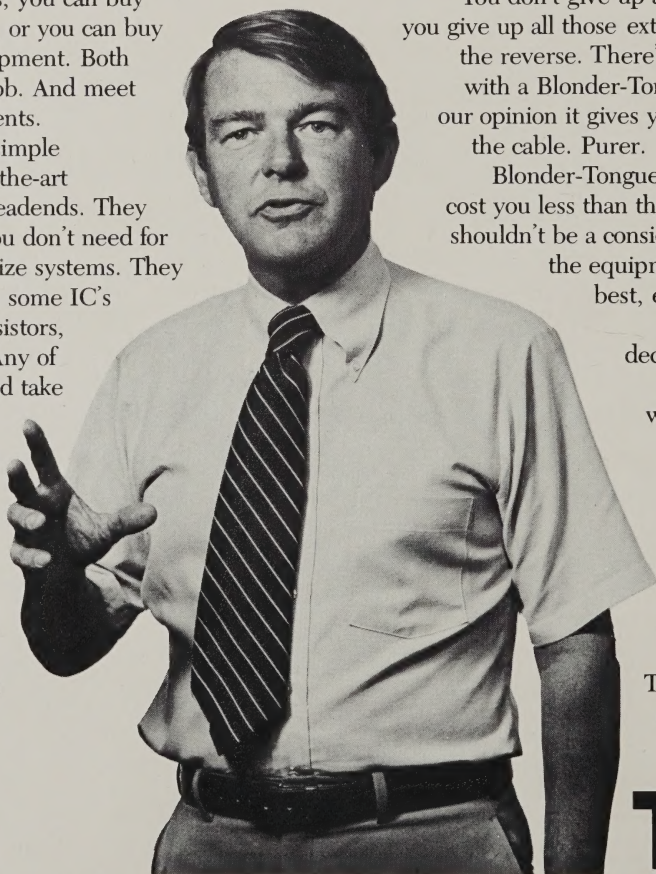
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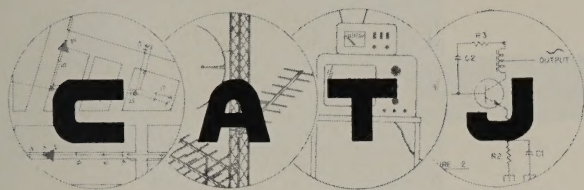
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September 1979

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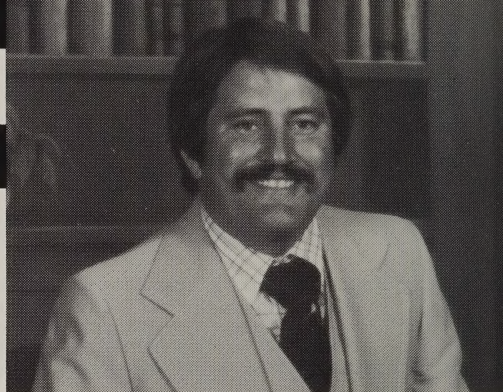
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OUR COVER

Back to the basics...cable systems under construction using that irreplaceable commodity called men on a pole installing an amplifier.

CATA "TORIAL

BEN CAMPBELL, President of CATA, Inc.



IT'S THE LAW

One of the principal jobs of any trade association, such as the Community Antenna Television Association, is to make every effort to see that the laws adopted in Washington D.C., and all the Statehouses around the country do not interfere with our business. Of course there are many laws that we don't like, and some that we do. In both cases our representatives have the task of convincing legislators to either change their minds and rewrite the laws, eliminate them, or write some that would be helpful to us. This is as it should be, it is part of the "game".

As you know, CATA has been deeply involved in the recent round of proposals, discussions, meetings, hearings, etc. on the proposed "rewrite" of the Communications Act of 1934. This would be the "big daddy" of them all in terms of getting the laws straightened out so far as cable television is concerned. It is a vast undertaking, and it does not look like it will happen any time soon, or at least not easily.

The first battles over "program consent" have resulted in the Congress pulling in its horns a little bit and re-thinking the proposals. That does not mean they won't come up again, it just means that with a lot of hard work, and plenty of support from our membership, Congress got the "word" that the "Program Consent" idea was not a very good one—that it would hurt the public and cable television in general. It was simply a bad idea. There will be others. "Program Consent" will turn into "syndicated exclusivity", and then probably come back again as proposed increases in Copyright fees. We have to be on constant guard that our interests are not lost in the shuffle, and that is what CATA is all about. We make every effort to assure that the laws that are written will benefit us, and the public we serve, rather than hurt.

However, it must be remembered that the law is the law. Once it is written and on the books we do not have the option of simply ignoring it, or hoping we will not be caught violating it. The more we conduct ourselves in that fashion the more likely it is that even more regulations will be written to hem us in. CATA does not condone any intentional violations of existing law.

The reason all this comes up now is some apparent confusion over an article that appeared in the April issue of CATJ on MDS service. We want to make it very clear that CATA and CATJ are not in any way proposing or condoning the violation of federal laws with regard to the interception of common carrier services—or any other law, for that matter.

I am spending a lot of time in this issue on this subject because in the past few months CATJ has experienced a great increase in readership by individuals, folks who are not necessarily a part of the cable industry and may not be aware of what our long-standing position has been. We may not like some of the laws we are forced to work under, and we may try to change those laws because they are either counter-productive, wrong, or just downright stupid—but as long as the laws are on the books we advise you very strongly to abide by them!

Specifically with regard to MDS, everyone must keep in mind that it is a common carrier service, and that the programmers using the service to reach hotels, motels, apartment houses or private homes are in business. No one has the right to simply build a home receiver (whether it is for MDS or satellite) and steal private signals coming from the MDS transmitter or the satellite. Unlike broadcast television, where anyone who can receive the signal with a rooftop antenna can use it, MDS and satellite signals are NOT broadcast signals. They are PRIVATE communications. You need specific permission to receive them, and view them—even if you are not "retransmitting" them like a cable system.

The private, home use (interception) of MDS or satellite signals without proper authorization is against the law. You can be fined, or even imprisoned for violation of the law. As far as the Federal Government is concerned you are the same as a wiretapper if you intercept those private transmissions without permission. Now, how do you get permission? Well, that might not be so easy. In the case of satellite transmission, of course, you need a construction permit from the FCC before you can even legally build a

TVRO antenna. Since you have that you must go to the program supplier (for instance Home Box Office, or Southern Satellite Systems for WTCG (17) in Atlanta) and get WRITTEN permission from them before you can legally look at the signal in your own home. Some program suppliers are willing to give that permission to individuals. Others are not. If you do not get permission, you may not legally look at the signal in question.

The interception of MDS service also requires permission from the programmer (usually through the local MDS operator, or the purveyor of the programming in the local MDS area). Such permission is usually even harder to get than with satellite transmissions. But you do have to have it before you go off and simply view the signal. In both cases the program supplier will probably charge for giving you the right to view the signal, if he allows you to view it at all.

It is true, and obvious, that enforcement of the rule against someone using unauthorized signals in the home is very difficult. But that doesn't mean it's impossible—and it is not the point anyway. Following the law is not based simply on whether you are likely to get caught or not—you follow it because IT'S THE LAW! If we all went around only following the laws we agreed with this country would be in chaos very quickly. We must all be accountable for upholding the law, even when we don't like it. In the case of satellite and MDS service, as I already mentioned, violation of the law can get you in a lot of trouble. It is also out and out theft of someone else's property. DON'T DO IT!

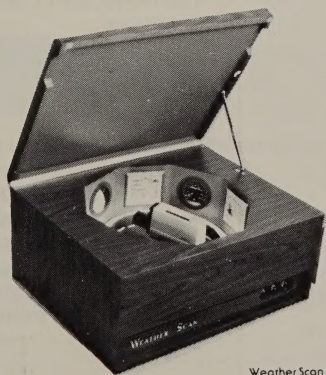
For those who insist on "taking on the challenge" of building their own terminals and stealing service I can only say that in the long run you will not only hurt

yourselves, but everyone else as well. For instance, in the case of MDS service, it is clear that the future—and it is not too distant—will bring MDS to home service. This is not a threat to cable service since MDS can only bring in one, or maybe two signals at most. But it is a very valuable service in those areas that do not have cable. By stealing the service you will force the MDS industry to institute scrambling and other anti-theft measures. They are sure to cost a lot of money. The net result is that everyone will have to pay more for the service because a few inconsiderate folks decided to ignore the law and steal someone else's property.

Understandably there are those who feel very frustrated right now because the local MDS operator (for instance) has not offered MDS to home service yet and you want it—presumably because there is not cable system where you are either, so it is a matter of the "only game in town". I have a suggestion for you. Go to the MDS operator in that case. Explain what you want to do. Offer to pay the going rate for viewing the service, and then go to your work-bench and see if you can design a cheap, adequate reception system. If you do you probably are on the road to a long term relationship with the operator because that way it would be in his best interest too!

The bottom line on all this is simple. It is not in anyone's long term interest for folks to be breaking the law. In so far as MDS and satellite reception is concerned you MUST get licenses and permission to view the signals offered on those two services. If you don't, you are hurting yourself, and everyone else around you.

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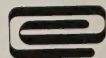
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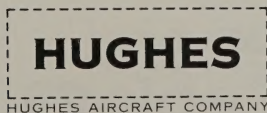
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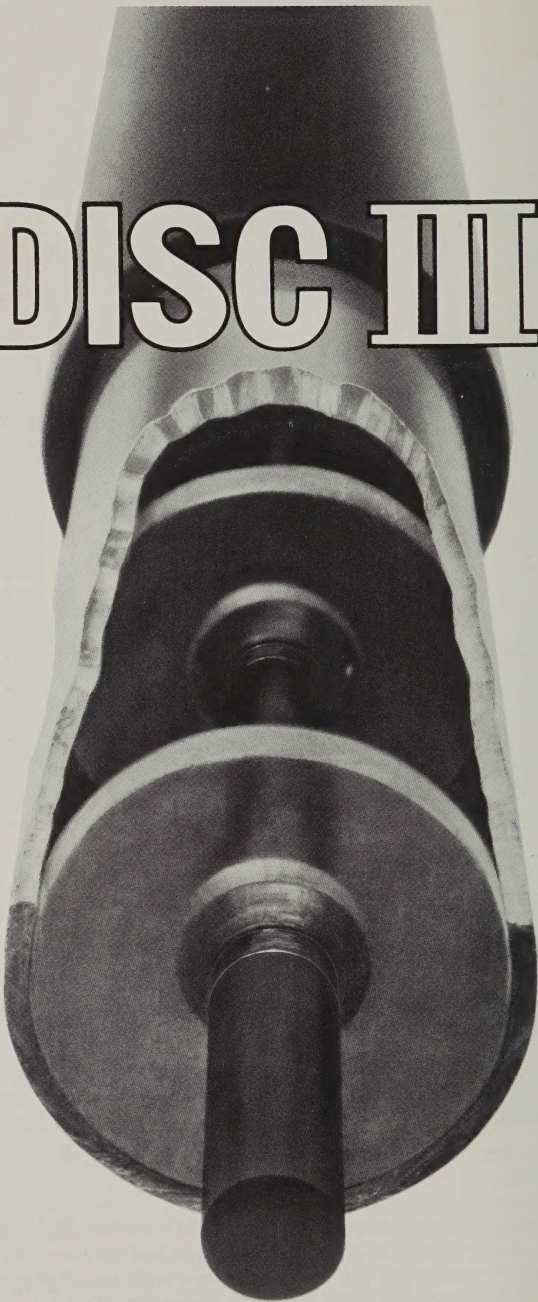
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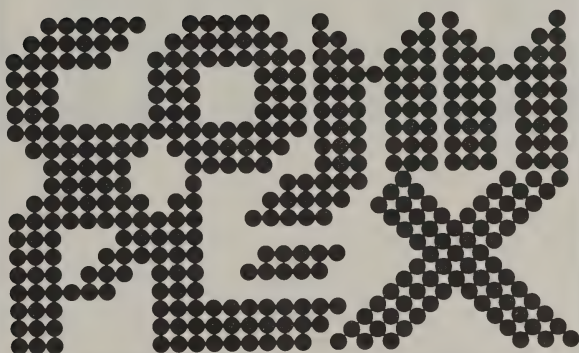
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Noise Poses One of the More Common Difficulties in CATV Systems

SYSTEM PLANNING

Ideally, in your system planning, you look and look for the **perfect** headend location, but generally a compromise, or several, has to be made as there are few of those **perfect** situations. Generally the CATV head end is located in the outskirts of the town to be served, and away from the busy traffic areas where the power distribution lines would be within the immediate vicinity.

In your system planning, the considerations should be the land availability and the price thereof, the distance that the trunk length would run, and the cascade of the trunk to the farthest ends of the community that the system would serve. In selecting the site for the tower, the local zoning ordinances, as well as FAA approval, would be prime considerations before making the final decisions.

BUT, regardless of the careful planning and selection of site, most CATV head ends will have **some** noise present on **some** of the channels **some** of the time, and CATJ has been asked to explore this subject matter.

Just what exactly is CATV system noise? It can be identified with one of four different sources:

1. **Atmospheric noise** - the natural phenomena created by electrical discharges, such as lightning accompanying thunderstorms.
2. **Amplifier noise** - the creation of excessive **noise figures** in one (or more) of the signal amplifiers, beginning at the head end and continuing through the entire plant;
3. **Man made electrical noise** - noise originating on power lines fired by electrical sparks on electrical or combustible equipment;
4. **Out of band noise radiation** - the creation of signal processing units (on-channel strips and heterodyne signal processors) which generate **noise** on adjacent channels in addition to processing signals on the desired channel.

Man-made electrical noise will be detailed in this issue, and, as we promised in the August issue, Dr. Rodney Bent, Altantic Science Corporation, Indian Harbor Beach, Florida, will ex-

plore the highly fascinating and pertinent subject of Lightning and Power Surges in a subsequent issue of CATJ. His presentation at CCOS-79 was a highlight of the program, and because of the tremendous interest in it by those who did attend and those who could not attend CCOS, we have asked Dr. Bent to prepare material for CATJ on this, and you can look forward to this sometime in the near future.

Amplifier noise and out-of-band radiation from processing equipment will not be covered either until a later date. These all seem to be subjects very much of interest to CATV operators, and while there has been previous discussion, the ever-present problem of **noise** was mentioned as a subject for further exploration and discussion.

MAN MADE NOISE

These have to be among the most aggravating to the CATV system operator!! In addition to the common noise sources, such as the ignition noise from combustion engines or that created by electrical motors, there frequently is noise that originates in the power distribution lines, or even worse, in some machinery or appliance and this is then carried down the power distribution

NOISE PATHS

There are three common noise paths to your receiver from the noise source.

CONDUCTION takes local noise from a source to your receiving equipment through the service wiring in the facility and into the power supply of your equipment through the 110 VAC connection. At VHF ranges, this mode of noise transmission usually comes only from sources **very close** to the receiver.

INDUCTION paths follow the power lines, metal fences, barb wire, etc. telephone company strand and other inducible materials. Noise sources at VHF usually follow induction paths for only short distances before they either attenuate below interference levels or convert into radiation paths.

RADIATION paths are the most common problem paths at VHF. The source couples into a radiator (or antenna) which in turn allows the source to radiate through the air.

lines for several miles, radiating all the way along the transmission path.

To these add the common problems created by electrical fences, used by many stockmen; any version of these electrical fences have the potential of being a **real** problem. Or then there's the neon sign on the cafe down the road, maybe only a mile or so. These can develop into an endless variety of problems working against you to make interference-free pictures for your subscribers. But before you can do anything about this to either fix or repair the noise problems, you have to be able to locate the **source** of the problem! Keeping in mind **all** the things it could be, the apparatus causing the noise does not have to be a point-radiation source. That is, the malfunctioning device creating the noise **may** not be the only radiator of the noise generated.

To put it another way, if a malfunctioning electrically operated mixer can (and often will) radiate not only from the appliance itself, but will also radiate from the power lines that feed that restaurant back as far along the power lines as the lines are isolated from the balance of the power distribution system by an isolation transformer (or step-down transformer). If this restaurant is on its own secondary power, the wiring within the facility is all of the **antenna** that the mixer would have, and its interference range would be limited by the **gain** of its antenna. Radiated noise tends to be broad band in nature. To put it another way, noise created by virtually any source travels further at the low frequency end of the scale than at the high frequency end.

BUT, this is a very useful trait then because this allows us an opportunity to devise a relatively simple solution on the source location problem. Diagram One illustrates an actual noise tracking experience. The noise from this source (a loose

NOISE METER — FM

The simple noise (audio level) indicating meter shown here can be constructed in a mini-box and plugged into the earphone jack on a portable FM receiver. The 0-500 micro-amp meter with a detector diode (1N914) alone, *without* an RC circuit (R1, C1), will react wildly to individual audio spikes from the noise source. R1, C1 were chosen to *dampen* this reaction so the meter movement slowed down.

With the particular receiver/meter you may employ, you may have to experiment with the RC values to arrive at a proper dampened value to keep the meter slow enough to not react to small variations.

Another potential problem is a receiver with an AGC system that will not allow noise input *up variations* to translate into increased meter readings, in which case disable the receiver audio AGC.

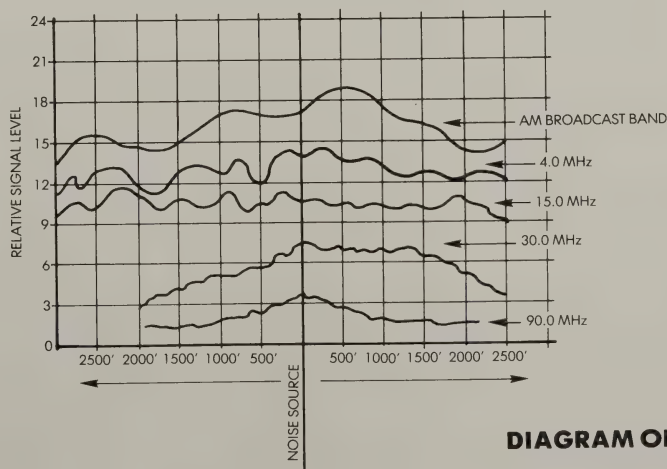
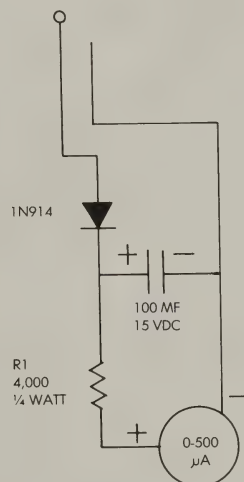


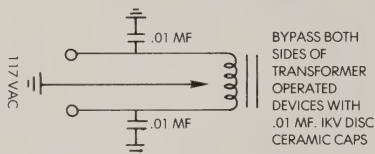
DIAGRAM ONE

REMEDIAL NOISE ELIMINATION STEPS—SOME SOURCES

Keep in mind that the local electrical company can be held accountable only for noise which their system creates, and that noise created by their service customers must be handled between you (the offende) and the customer (offendor) of the electric service.

One of the most effective known noise eliminators is a capacitor, as large (in capacitance) as possible, placed as close to the noise source as possible. *NOTE:* In the case of portable appliances, the capacitance possible is limited by UL codes which state that the maximum current to ground through the capacitor may not exceed 0.3 mA to prevent electrical shock to the user.

General procedures follow:



Thermostatic Devices Filter as close to make/break contacts as possible.

Neon Signs Insulate thoroughly from metallic surfaces; replace defective neon tubes; bond together any isolated (floating) metallic material in the field of the sign.

Oil Burners/Ignition Type Industrial Equipment Install heavy duty supressor-type spark plugs and capacitive-type line filter at Unit AC connection. Bond motor, burner unit and furnace to an effective earth ground.

Commutator Type Motors Turn down (resurface) commutator, reseat brushes, filter at motor and ground case to belt to reduce static discharge.

Belt Static Bond machines together and directly to ground. Apply graphite type belt dressing to belt to reduce static discharge.

RF Heating (including diathermy, induction, dielectric) Determine operating frequency and harmonics (often centered near 27 MHz which makes dandy 54 MHz (2x) and 81 MHz (3x) harmonics). Unit should be well shielded and grounded to good earth ground. To cut down interference, reduce drive to final (output) amplifier and install traps or filters to cut out harmonics.

down guy on a power pole that allowed electrical energy to discharge intermittently to the ground) could be heard over a wide area (several miles) on an AM automobile car radio. In fact, tuning the car radio to a locally clear AM frequency clarified the sounds that were heard. At this low frequency, several other noise sources could be heard and the mixture of these, propagated by the power lines, left the tracker with the feeling that he was going in every direction.

By placing a shortwave receiver in the car on the front seat, and installing a temporary 100-140 inch steel whip antenna to the vehicle on insulated clamps, the tracker can start off on the low frequency end of the radio spectrum and drive out

the suspected area looking for noise. As the noise is heard in the AM broadcast band, he then would move to a clear, non-signal occupied spot in the 4.0 MHz region, and if the noise is heard there, move immediately then to a clear spot in the 15.0 MHz region. As you get closer to the noise source, you will be able to hear the noise on the higher frequencies.

By the time you get to the 15.0 MHz region, you will be getting within a few blocks of your problem. The signal level meter, or "S" meter as it is commonly called, can be a most useful tool operating on the battery shortwave receiver at this point because it will indicate the relative level of the noise as you are driving along.

However, be aware that the "S" meter can mislead you (refer back to Diagram One). Noise sources propagated along the power distribution lines tend to go in and out of **phase** as you drive along the line. This results in a wide variation in the indicated level even within a distance of 100 feet (or less), giving you the false impression that you have passed the location of the noise source.

To solve this phase problem, the tracker must constantly move into **higher** and **higher** frequencies with a noise-seeking receiver as he moves closer and closer to the source itself. You could switch to a battery operated FSM which has a built-in meter which is useful to indicate noise level, and a dipole or whip antenna once you have moved beyond the 30 MHz upper limit of the battery operated receiver.

While you can use a FSM in a bind, it will usually **not** have the adequate sensitivity to handle the relatively low noise signal levels present. So, a better technique would be to use a small hand held portable FM receiver (covering 88-108 MHz). The device shown in Diagram Two is a simple signal level meter which plugs into the earphone jack on the portable FM receiver. FM receivers are commonly available in this configuration and have sensitivities of 1/2 micro-volt for 10 db quieting. This puts it 10-20 db ahead of most FMS's for low end sensitivity.

When you reach the point in your noise search where you can detect noise in the FM broadcast band, you are within 500-1000 feet of the trouble source (see Diagram One).

EFFECT OF RF FREQUENCY ON NOISE SOURCE LOCATIONS

Lower frequency noise components tend to propagate through and around power line transformers. In the AM broadcast band, noise heard may actually peak higher in intensity at some point other than the noise source, than at the source itself. This is also true through the lower half of HF (high frequency) region up to approximately 15-30 MHz, where the region begins to become more localized. By using lower frequencies to spot the area where the noise is located, higher and higher frequencies are utilized to pin the source down to a specific area. Final determination is made by using the FM broadcast band as a location-frequency-range.



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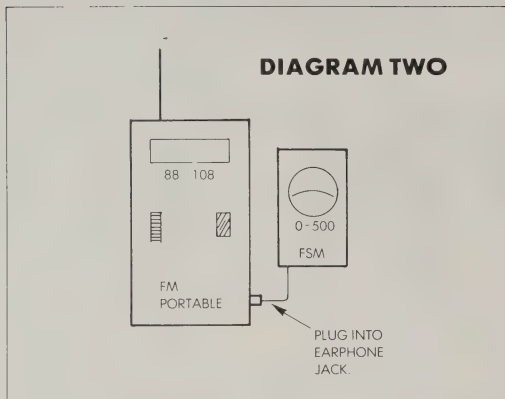
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At this point you may have trouble pin-pointing the actual device causing the noise. This is because power down guys, service drops, and even nearby cable lines can re-radiate the noise source. Because you are doing your leg work under the power lines, with telephone and cable between you and the power lines, considerable phase and re-radiation can be expected. All of these sources tend to mask the true point source of the radiation.

However, once the source is pinpointed, you have the problem of correcting it. You do have the advantage of the law at this point as machinery or power lines that radiate noise are in violation of **FCC Rules** and must be corrected when brought to the attention of the owner.

You will usually find the utilities to be helpful, but they are generally under staffed, especially in the case of those crews that the utility companies maintain to locate such things as noise sources. If you merely turn in a complaint that they have noise **somewhere** on "Any Street", you are asking them to send out their noise locating expert to find the noise. But, if you turn in a complaint that says "**pole number XZY-456 is radiating noise,**" the power utility can by-pass their locators and schedule a line crew to take care of the problem. This will save you **weeks** of waiting and get the problem solved much faster.

Once the crew is scheduled on the location to fix the problem, you should also be there with

CATV RECEIVING ANTENNA ARRAYS V. NOISE SOURCES

Designing an antenna array which will provide the greatest degree of protection against lightning noise demands that the antenna array have (1) highest possible front to back ratio, (2) highest possible front to side ratio, and, (3) lowest possible front angle-of-radiation. This is not unlike the type of pattern which you require for minimum co-channel or minimum pick up from discrete noise sources that you cannot control, such as highway traffic.

Any type of yagi antenna array makes a poor choice for this situation since a yagi not only has a number of side and rear lobes in the horizontal plane, but it also has a number of minor up and down lobes in the vertical plane, some of which are extremely responsive to signals that come to the antenna at elevated angles of 3, 5, or 10 degrees above the horizon (which lightning-within 50 miles definitely does).

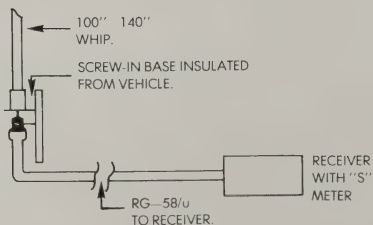
Many systems with -10 dbmv to 0 dbmv inputs from their present antennas (ie. a single yagi or log) on low band channels could measurably improve their rejection of lightning discharged RF by changing out to a log antenna array. A log antenna does not exhibit the many minor vertical plane lobes of a yagi, and as a consequence it will reject these high-angle-arriving signals better than a yagi. An array consisting of four logs, spaced two wave length wide by one wave length high (ie. a box array of four logs) will not only improve the signal to noise (including lightning) ratio, but will reject lightning caused noise from any storms except those directly in front of the array on the antenna heading.

your noise locating equipment. A line man on a pole, moving wires and hardware around while you monitor on the ground can be directed as to what piece of hardware, ground bond, etc. is at fault. As he moves things around, you will be able to see the results on your noise-indicating receiver. If by some chance you indicated the wrong pole, and the lineman is on the spot, you can usually get him to check the poles on both sides for the problem as well. This allows for a margin of error handling it in this manner.

While the power companies **know** the FCC rules and **know** they must cooperate to fix a problem that you may have (or risk a bout with the FCC), the restaurant with the defective appliance or the theater with the faulty neon sign may be **something else**. While the **law** is on your side, it is not something that local law officials handle. The best solution would be to get the problem handled in a friendly fashion with the owner of the equipment, but if you cannot get this accomplished, your only recourse is: public opinion (the word would get spread around that it

190 KHZ-30 MHZ NOISE LOCATOR PACKAGE

The equipment suggested consists of the following: A battery operated receiver that covers the range 540 kHz to at least 30 MHz; a whip antenna (steel Citizens Band 102" whip is adequate) mounted on an insulated base so it floats above the vehicle body ground shell; a short length of RG-58/U (50 ohm coaxial cable) connecting the whip to the battery operated receiver. By isolating the antenna and the receiver from the vehicle, vehicular (ignition) noise is minimized. If ignition noise (pulses) from your vehicle can be heard, switch vehicles or take steps to cure the noise originating in your vehicle. See text for information on test procedures.



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INTERFERENCE SOURCES

Interference categories break down into a trio.

SPARK DISCHARGE sources are common household appliances and thermostatically controlled devices. Brush type motors found in portable mixers, electric shavers, vacuum cleaners and small shop motors are troublesome spark discharge devices, which tend to have potent near-field interference potential but, because of the small motor sizes, seldom radiate more than a few hundred yards.

Thermostats located on heating pads, aquarium heaters, water heaters, and chicken brooders have a slow-break contact type of construction. When these contacts break, an arc occurs which produces a spark discharge. Items such as brooders, electrical fences, and carbon filament light bulbs (still found in rural areas) can affect a large area with interference because of the large radiating antenna are often connected to them.

The typical sounds associated with the spark discharge are a frying or grinding sound, popping or buzzing. The thermatic devices have a characteristic sound that goes *bzzt* for several seconds and then off for a few. A roaring, frying noise that comes on and *stays* on for some time, or goes on and off randomly, is characteristic of a defective power line (ground). In rare situations, it may come on and go off at certain times, but, if it does, check the time local street lights come on and off as the source may be a power line feeding a street light.

RF RADIATION - there are many devices capable of RF radiation, such as heliac welders, induction soldering machines, TV receivers, TV mast mounted pre-amps and diathermy machines being among the most common. The sounds associated with this kind of interference are whining, buzzing, whistling, or warbling. The picture usually has an RF beat appearance to it.

In small communities, an old mast mounted pre-amplifier left plugged in and forgotten will often partially fail, particularly when one half of the twin lead on the input fails. In this unloaded condition, it will oscillate, causing an RF beat in one or more channels.

Diathermy, heliac welders, induction soldering machines, and TV receivers that radiate RF interference usually require better shielding.

ELECTROSTATIC DISCHARGE - this type of interference source often has no direct connection to electrical circuits. Guy wires rubbing together, dissimilar metal down spouts, and gutters moving against one another in the wind, roof top weather vanes, or loose ground bonding straps on totally cold strand lines are common causes.

is a company's error that is creating the blemishes in their television channels), or filing a formal complaint with the nearest FCC regional office.

There are people in a community, such as the banker, mayor, or city officials, who might swing more weight with the utility company or the offending business than you, and you could seek their assistance to obtain the cooperation of the utility company to correct the problem. **BUT**, if that fails, you are back to filing a formal complaint with the FCC, and this would include, in detail, what you have done to locate the noise course, and your efforts to contact the owner of the defective equipment to correct the fault voluntarily. You must also explain how this defective unit is causing harm to your service, pointing out that you are operating under the rules and regulations of the Commission, but that you cannot deliver quality pictures required by the Commission as long as the uncontrolled interference source continues to operate defectively.

This should **always** be done with a copy of the letter to the owner of the defective unit so that he knows that you mean business and that you have reported it to the FCC. He in turn will know that he can expect to hear from the FCC as well. Commission field offices are swamped, but eventually they will respond to your request for assistance and will be in touch with the offending party. The FCC will attempt to handle the matter by correspondence, but if they find that they cannot do so, they will send an engineer to inspect the problem.

This would not be a speedy reaction, and might take several months from the time you contact the FCC, so an overnight solution just wouldn't happen. Again, your best bet would be to approach the problem, as friendly as possible, from the local level and proceed from that angle.

As we told you earlier in this article, the other sources of system noise will be explored in later issues.

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CATJ Repeats...

CATJ is appreciative of the good response to our Reader Survey, and, as a result, we had many requests for repeats of articles from past issues. Those subscribers who have not been able to get all the back issues since the first issue of CATJ (May 1974) have been most encouraging for re-runs of some of the construction and antenna articles, as well as head-end receiving situations, system lay-out and design, and much, much more. We will be running some of these in subsequent issues, beginning with the one below. If you did not fill out your Reader Survey card from the July issue, we encourage you to take advantage of this opportunity in this issue, as we want to be able to furnish this timely and useful information to those who may have just recently joined us as a subscriber to CATJ.

From CATJ October, 1975

MULTI-MODE RECEIVING ANTENNA ARRAYS REDUCE SCATTER REGION SIGNAL FADING

Part 2,
Continued From August 1979

Circular Polarization

Because the scattered (globule propagated) signal knows no polarization loyalty *once it moves into the scattering region*, separate antennas for vertical and horizontal wave fronts are only a *partial solution* to the problem. Because a 90/270 antenna exhibits *some* degree of efficiency for off-plane signals (such as 60/240 through 120/300), logically the 0/180 antenna will do the same (i.e. 330/150 through 30/210). However, evidence indicates that the efficiency of the antenna does fall off quite rapidly as the plane of the signal *differs more than 10 degrees* from the plane of the received wave front.

One answer to this problem is to incorporate into the receiving-antenna array a circular polarization arrangement wherein the receiving antenna exhibits polarization response in *all planes* from 0/180 (vertical) through 90/270 (horizontal) through 180/0 (vertical again but *not* the same as 0/180) through 270/90 (again, horizontal but *not* the same as 90/270) and finally back to 0/180.

Accordingly, CATJ began a series of off-air receiving tests utilizing just such an antenna array on a scatter-region (distance) path in the late spring of 1974. This project has been continuing for nearly 18 months, and very extensive signal studies have been performed during that time.

From the thousands of feet of chart recordings accumulated during that period, a number of conclusions have been reached. It is our belief, based upon this series of tests, that extensive *new data*, as relates to CATV system operation, is now available. Accordingly, this series of reports is being inaugurated in CATJ.

Reference is made to Charts D and E. These charts show the same scatter-level signal as received on two separate antenna systems. One antenna system is a standard horizontally polarized (90/270) antenna. The fade signature is not dissimilar to that found in chart A. Now study Chart E. This chart is made when the *same signal* was received on a *circular polarization* receiving antenna.

Instantly, it is apparent that the rate and depth of fades are *modified extensively* when the receiving antenna is *circular*. In fact, the *depth* of the fade swing evident on the 90/270 (horizontal) antenna is markedly reduced on the circular antenna.

It would be well to remind everyone at this point that the transmitted wave front is horizontal, that is 90/270 with respect to the flat plane of the earth. The signal received on Chart D is being received on a horizontal antenna; the same 90/270

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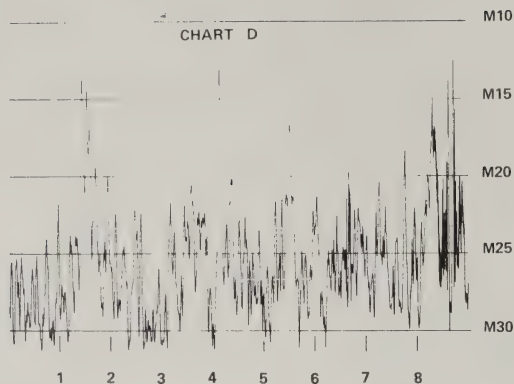


CHART D—Beyond-horizon high band (VHF) signal as received on 8 bay horizontal (polarization) log antenna array. Fade rate is through 20 dB swing range in this example. Time marks are in minutes.

plane with respect to the earth as the transmitting-antenna plane. Chart E, on the other hand, is prepared from the received signal on a *circular* polarized antenna, one that exhibits a constantly changing, linear, twisting polarization sense.

From this simple graphic presentation, some conclusions can be drawn.

- (1) The two antenna systems differ primarily in that *one* (D) responds only to a polarization

"Dictionary Of Terms"

A number of **new terms** not commonly found in CATV (or other) print appear in this report. To insure that you have minimal difficulties following the "new language," we provide the following definitions:

Horizontal (polarization)—A plane that is parallel with respect to the earth's (assume flat) surface;

Vertical (polarization)—A plane that is perpendicular with respect to the earth's (assume flat) surface;

Wave Front—The graphic portrayal of the transmitted wave form, embodying its respective polarization form;

Skewed—A twisting of the wave-front polarization, meaning that the original polarization of the transmitter is no longer present;

Repolarized—Skewing of the original wave-front polarization to a new, known or measurable polarization;

90/270—Mathematical designation for horizontal polarization;

0/180—Mathematical designation for vertical polarization;

Scattering—The propagation mechanism whereby signals travel beyond radio horizon to some distant point where no direct-wave reception exists;

Scatter Region—That portion of the total path from transmitter to receiver where all reception is via "scattering mode" propagation;

Globule—A very small region in the atmosphere where the refractive index of the region is measurably different from the surrounding atmosphere;

Globule Mode—The mechanism that creates the scattering mechanism;

Pocket Concentrations—An area in the atmosphere where a high number of globules exist, creating a concentration of scattering mechanisms;

Fade Range—The decibel range through which a received signal fades;

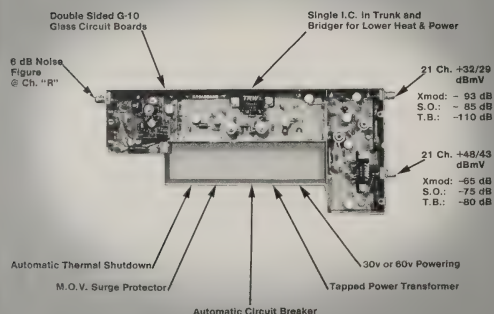
Helix—A special form of antenna exhibiting circular polarization;

Multi-Mode Polarization—An antenna polarization "system" that combines two or more polarization formats (i.e. vertical and horizontal) or all formats (i.e. circular) into a single transmitting or receiving antenna.

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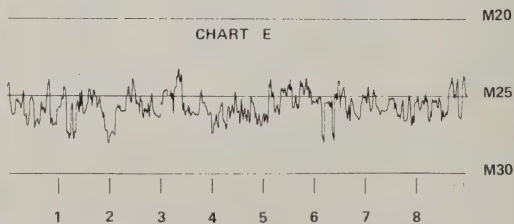


CHART E—Beyond-horizon high band (VHF) signal, same as chart D, except receiving antenna is circular polarized Helix antenna, single stack (i.e. bay). Note that fade rate is through only a 3 dB swing range in this example. Time marks are in minutes. Charts D and E were made simultaneously.

format which matches the *original* transmitter polarization format;

- (2) This particular receiving antenna shows widely varying signal voltage levels present, over a 10-15 dB fade range;
- (3) A second antenna, with no *singular* polarization loyalty (i.e. responsive to all polarization formats), exhibits a fade rate more than 50% lower.

We must therefore assume, with few trepidations, that the multi-polarized receiving array exhibits *lower fade rates* simply because the twisting, skewing polarization of the *received wave front* is always matched plane for plane by the multi-polarization format of the circular antenna.

Or to put it another way, the big deep fades found on the 90/270 antenna are largely attributable to the received signal varying widely *away from the 90/270 polarization format*. That is, as the signal twists to an extreme of 0/180 during its flight to the receiving antenna, the 90/270 plane antenna captures less and less signal, which displays on the chart as a deep fade and a sudden signal reduction. Lower rates of skew (i.e. to 45/225) also produce fades (lowering in signal level present), but the 90/270 plane receiving antenna still captures *some* of the signal present; thus the fade at that point is *not as severe*.

Note if you will on Chart E that *we still have the smaller +/- 3-5 dB fades*. These are, we believe, primarily caused by the *phase addition and phase cancellation* of signals arriving at the antenna via paths other than the true shortest-direct

path. Signals traveling arced paths add and cancel each other continuously, resulting in the lower fade rate shown.

Practicals of Circular

This might suggest instantly that for CATV receiving paths that are operating in the scatter region one excellent way to greatly *diminish signal fading* (i.e. chopping) is to *replace* existing horizontal (90/270) antennas with circular polarization antennas. This is more than logical, but it is not altogether practical.



A circular polarization antenna is, in our 18-month test-situation, best represented by a *Helix* design. The Helix antenna, often employed in terrestrial-to-space communications, is *not* dissimilar

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to the Yagi-Uda in *response patterns and gain*. That is, most Helix antennas exhibit gain that is comparable (for the same boom length) as Yagi-Uda antennas (perhaps a bit lower than the Yagi-Uda). And the receiving pattern (i.e. response of the antenna to side and rear lobe signals) is equal to or again slightly *worse than* a Yagi-Uda.

As you can see from the photographs accompanying this report, the Helix utilized by CATJ is constructed so as to end-mount from tower legs. The corkscrew affair is the actual antenna element, winding its way (as it were) from the nose (front) of the antenna to the rear of the antenna. The size of the "coil" (i.e. the diameter), the spacing between consecutive coil turns, and the number of complete rotations around the support structure (i.e. complete rotations) per wavelength at the operating frequency are all important *design* considerations. Additionally, the antenna tends to have a match that must be transformer-coupled to a 75 ohm unbalanced line.



In real VHF life, the Helix becomes *exceedingly* large (and therefore difficult to install and keep up) once we go *lower* in operating frequency than *highband* VHF. Or, it is *not* a practical antenna for channels 2-6.

Our original concern with the Helix constructed for our tests was that it would not stay together long enough to give us meaningful test results. Frankly, we were surprised that it did (it is still in operation as this is prepared). We simply took a stout redwood 2 X 6, coated it several times with an acrylic product to try to preserve the wood (wood was chosen because it has insulating properties, which are necessary to keep the turns mounted to the wooden boom from shorting out), and using some stout number 10 wire, wound our Helix according to the formulae. The back screen (for front to back and match) is heavy 0.5-inch mesh, supported with an "X" wooden back frame attached to the 2 X 6.

However, in addition to the problems associated with the construction and size of the Helix, we were also concerned from the very beginning that in the process of *potentially solving* the rapid fading-in-gain-due-to-signal-repolarization aspect of our situa-



tion, we would simultaneously return to the Yagi-Uda era of *objectional co-channel interference*. (Once again, the Helix has pattern-response characteristics *similar* to the Yagi-Uda, only not quite so good in front-to-back or in side-lobe control.) To put it another way, we *might* cure or diminish the pumping/chopping fading problem, but if we brought co-channel back, what had we really gained as far as the viewers were concerned? Not much.

Other Forms Of Circular

There are other techniques to arrive at circular polarization. For example, if two discrete sets of elements (one 0/180 or vertical and one 90/270 or horizontal) are mounted on the *same* antenna boom, and each set of elements (i.e. read antenna) is fed with a *separate* coaxial line, there are tricks in *combining* the two separate antennas so that when combined you have not two separate planes of polarization (i.e. one vertical and one horizontal), but rather you have *circular polarization*.

If you do this with two Yagi-Uda design formats, you end up with an antenna that works like a Helix but looks like two Yagis on the same boom. This solves the low-band *size* problem, but it does *not* solve the antenna-pattern-response problem.

If you do this with two LPDA antennas (logs), you can solve both the polarization problem and the Helix construction problems, but you pick up a few new mechanical problems in the process. We will cover these aspects of the problem and apparent solutions in a later portion of this CATJ series.

Commercial Interest

Circular or crossed-polarization is not *new* at the broadcasting end of the circuit. For many years FM broadcasters have employed both cross-polarized antennas (i.e. *separate* transmitting antennas, one set vertical and one set horizontal), and more recently FM broadcasters have been installing *singular* antennas with *circular polarization sense*. FM broadcasters do this for one obvious commercial reason: as FM radios in automobiles have become increasingly popular, they have adopted

either vertical and horizontal or circular polarization so as to be able to adequately serve not only the home (horizontal) market but the mobile (vertical) market as well.

Because television reception in automobiles is either illegal (many states if the vehicle is in *motion*) or unwise (at best if the driver is distracted), the television broadcasters have not found *similar* reasons to adopt multi-mode polarization.

Still, approximately one year ago, station WLS-TV and its parent company, the ABC network, did install in Chicago (on WLS's channel 7) a test of multi-mode polarization. The tests have run along for sufficient time now that some results are beginning to leak out. According to the test conductors, the use of multi-mode polarization at WLS-TV has brought *significant improvements* in signal coverage in (1) the close-in areas, especially with receivers equipped with (*vertical*) rabbit-ear or indoor antennas, and (2) in the fringe area where a measurable reduction in co-channel interference has been apparent.

Of course the close-in sets *could* be expected to have better WLS pictures on their indoor antennas with multi-mode polarization; after bouncing and twisting around the high-rise buildings near the downtown section of Chicago, the original horizontal WLS signal was *anything but* horizontal anymore. And with many indoor antennas more vertical than horizontal in receiving sense in the first place, the multi-mode simply makes good sense.

The fringe area, during this particular (current) test, offers a number of CATV-related opportunities for experimentation. For example, as long as WLS is the *only* station on channel 7 in the area using non-horizontal polarization, CATV systems in the *fringes of WLS coverage* would find that by simply *turning* their channel 7 array *over* from its present 90/270 horizontal-plane mount to a 0/180 vertical-plane mount (1) the signal level from WLS should remain the *same*, while (2) the co-channel interference from *other* channel 7 stations (or adjacent channel interference from channel 8 stations) should drop by 20-35 dB. The same thing would be true for home antennas erected for channel 7.

It should be emphasized that this is a useful trick *only* as long as WLS is the *only* user of multi-mode polarization; *as soon as others follow* (more about that shortly), your receiving installation will be right back where it is today with 90/270 plane polarization.

The success with the WLS test (conducted with the sanction of the FCC, which is participating in the analysis of the test results) has prompted ABC to work out an agreement with a UHF station in California: KLOC-TV, channel 19 in Modesto. There, in tests just now getting under way, the experiment will be repeated. The purpose of the UHF tests is to measure *not only* the changes in signal level within the respective KLOC contours

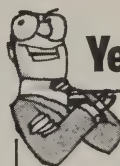
(as measured on standard 90/270 horizontal antennas and as measured on *special* circular receiving antennas), but also to check out the signal quality from the KLOC channel 19 transmitter as received on the common back-of-set *loop* antennas employed for in-home UHF reception. The loop, you see, is basically a *circle*.

So there exists the possibility that at some *not-too-distant future point in time*, the FCC will authorize *all* television stations to employ circular polarization *if they so choose*. And *if* this comes to pass, a whole new set of rather exciting possibilities will be opened up for the *CATV engineer*. We will explore these one by one as this series continues.

Weather vs. Fade Signatures

Our original premise with our CATJ test program has been to determine *how today* we might improve CATV picture quality by designing a receiving antenna system which would be more responsive to the changing, twisting polarization sense of the received wave front.

The reason the Helix multi-mode polarization system responds so favorably to scatter-path signals is singular: *the received wave front is itself*



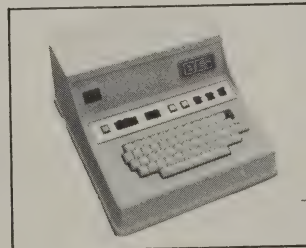
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constantly varying in polarization. That is the only apparent condition when there is an advantage to multi-mode receiving polarization.

Therefore one of our test program objectives was to determine, with a fair degree of accuracy, just *what percentage of the time* such techniques might be advantageous. If the time span was small (say 10%), we suspected that few if any systems would rush right out and replace their existing antennas with circular multi-mode plane antennas; it would simply not be a worthwhile exchange.

Propagation conditions vary throughout the North American continent. This is because the scatter mechanism depends to such a large extent on the presence in the lower atmosphere of globules of dense concentrations of moisture (an enlarged rain drop as it were, although not literally) or higher than/lower than temperature pockets. These wetter than/drier than, or warmer than/cooler than pockets or globules are in a sense *miniature repeaters*. They take the wave front in, then through a reflection or refraction process release it (i.e. *retransmit* it). Because the globules or pockets exist several hundred to several thousand feet above ground, they are *miniature repeater stations in the sky*. The signals they capture and then release (through *re-radiation*) are stronger than we would receive *without* their presence, primarily because of their elevation above ground, typically several times higher than our receiving antennas. *And because of their multiplicity*. That

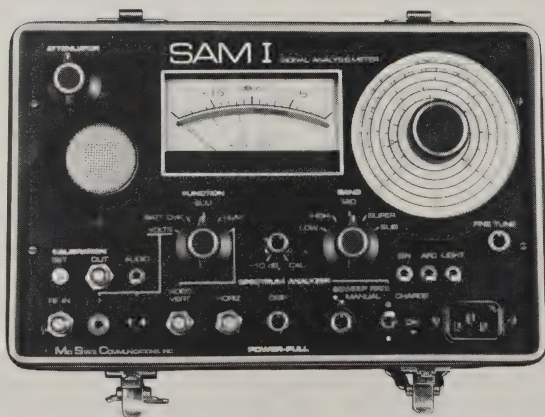
is, hundreds (or thousands) of them exist, and as each functions and re-radiates signals, there is some Rayleigh distribution of signal concentration at our receiving antennas.

Therefore, rapid, erratic fading conditions are a "signature" of the presence of polarization skewing and multi-mode plane transmission. By the same token, regions of the North American continent where such weather conditions exist to spawn this type of globule are regions where this condition is most prevalent.

Moisture is a *major contributor* to globule or pocket formation. Moisture is regularly present at virtually all times over or near large bodies of water. Therefore signal paths that run along the shores of the Great Lakes, or across the Great Lakes, or along or over the Gulf Coast, East or West Coasts are major examples of multi-mode plane situations. Reception over extreme distances along the Mexican portion of the Gulf of Mexico (where some systems carry off air signals 350-400 miles before cable carriage) occurs almost exclusively because of the presence of these globules or pockets.

Throughout the Midwest and over much of the South, especially in the spring, summer, and fall, the same type of condition exists. In the winter, the situation exists over large bodies of land *primarily* because of *temperature pockets*, not moisture pockets or globules.

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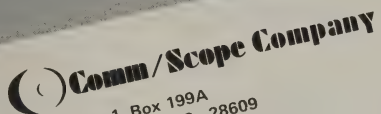
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Analyzing 18 months of chart recordings is quite a task. Still, patterns do evolve quite early, and it is therefore possible running through a year-plus of tests to pick out examples of periods when the 90/270 (horizontal) plane antenna is inferior to, equal to, or superior to, the circular (Helix in our test case) receiving mode.

Inferior To...

The 90/270 plane antenna is *inferior* to the circular-mode antenna system whenever there is *no signal enhancement* due to tropospheric bending (see Page 14, September 1974, *CATJ*, *VHF-UHF Wave Propagation*). This is reflected in Charts D and E here.

There is also the *slightest hint* that *perhaps* frequency-diverse fading (i.e. when the audio and video fade *separately*) is lower on the circular mode antenna than on the horizontal 90/270 mode antenna. This requires *additional study*, however; said study *should* be conducted in a region of the United States where such conditions are more frequently encountered (i.e. for example, in the Florida Keys).

On the average day, the circular multi-mode antenna is *superior* to the 90/270 horizontal-mode antenna (for reducing fade rates) as follows:

- (1) From 0600-0900 local time . . . 30-50% of the time
- (2) From 0900-1800 local time . . . 60-80% of the time
- From 1300-1700 local time . . . 80-90% of the time
- (3) From 1800-2400 local time, . . . 40-60% of the time

The multi-mode superiority is *greater* in the mid-summer and winter and *slightly lower* in the spring and fall.

Equal To...

The 90/270 horizontal-mode antenna and the circular multi-mode antenna *are about equal* for fade rate depths *only* when an enhanced signal condition is *forming*. That is, when there is a *transition period* between rapid-fading scatter-type signals and enhanced propagation level signals, the two

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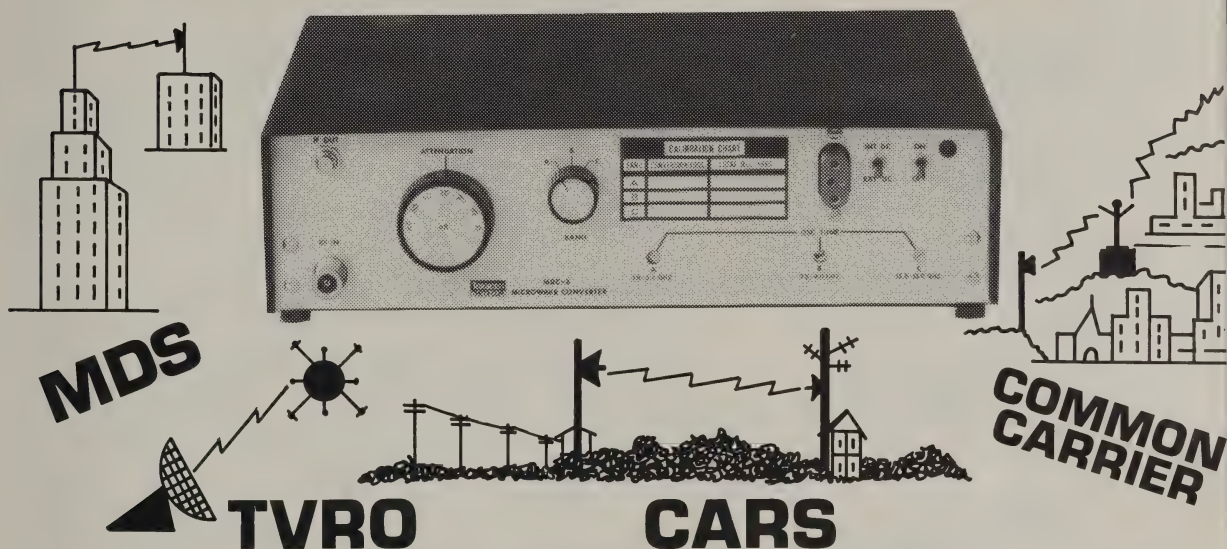
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arrays exhibit *very similar fading rates*. See Chart F as an example of this comparison.

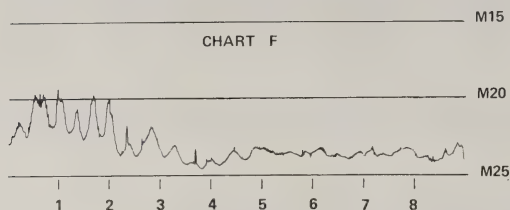


CHART F — Typical transition from tropospheric-scatter mode propagation to tropospheric-stable mode propagation (between 3 and 4 minute mark) with Helix antenna. Note fade swing range has reduced from 3 dB nominal to less than 1 dB nominal.

As a rule this transition stage between scatter and enhanced conditions lasts for a relatively short

period of time, often just a few minutes or less (see Chart B). It may last for a full evening, in rare circumstances; occurring perhaps 3-4% of the evenings in a year for a period of from one to five hours.

Superior To...

The 90/270 horizontal plane antenna is *superior* in fade-rate reduction to the multi-mode circular polarized antenna-receiving system *almost none of the time*. If both arrays have equivalent capture area (i.e. both occupy the same physical cubic feet in space), the advantages of the horizontal-plane array occur with such *rarity* that for all practical purposes they may be *discounted*.

Steve J. Birkill On Experimental Earth Terminals

Steve J. Birkill
Real-World Technology
128 Cross House Road
Grenoside, Sheffield S30 3RX England

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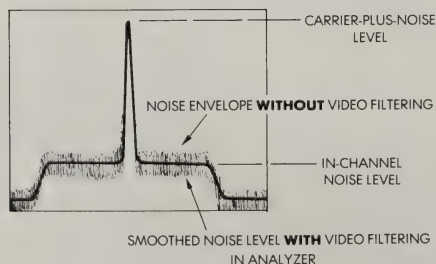
nitrogen — not the kind of thing found in the average head-end kit.

The operator's first encounter with his terminal's RF performance occurs when the antenna is aligned onto the satellite and the video output of the receiver inspected for 'sparklies' — the tell-tale speckling of video noise that indicates the terminal has insufficient margin above receiver FM noise threshold on the chosen satellite transponder. At the specification stage, starting from the published 'footprint' EIRP value for the transponder of interest, the antenna gain and LNA noise temperature will have been selected to achieve the minimum required 3 dB margin above threshold with the particular receiver to be used. Receivers vary in the precise value of carrier-to-noise ratio corresponding to threshold (defined as the C/N value at which signal-to-noise ratio has departed by 1 dB from its linear relation to carrier-to-noise ratio). A typical threshold is 10 dB, though threshold extension techniques


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The purchaser of a satellite receiving terminal or its component parts usually has to accept the word of the equipment manufacturer as to the performance of the radio-frequency elements of that terminal — **microwave test equipment** is in general **highly specialized and expensive**. Antenna manufacturers prove the performance of their products on large **antenna test ranges**, where measurements can be taken at sufficient distance from the antenna to enable 'near field' effects to be compensated. Low-noise amplifier noise temperatures are measured under laboratory conditions using 'hot' and 'cold' noise sources, the cold source (often referred to as a cold load) being **cryogenically cooled** with liquid

DIAGRAM 1 SPECTRUM ANALYZER DISPLAY FOR CARRIER-TO-NOISE RATIO MEASUREMENT



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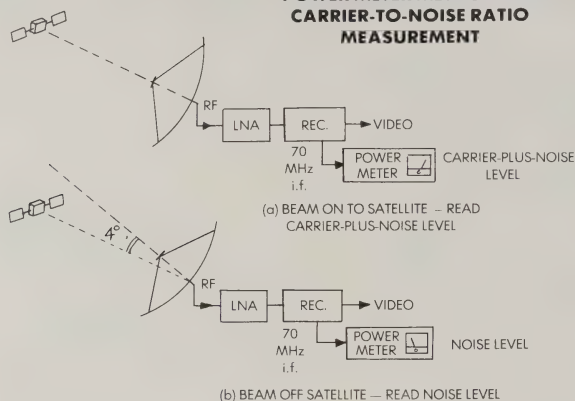
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DIAGRAM 2
POWER METER METHOD FOR
CARRIER-TO-NOISE RATIO
MEASUREMENT



employed in some receivers can reduce this to around 8 dB. Reducing receiver noise bandwidth (by i.f. filter selection) from 36 or 30 MHz down to 27 or 24 MHz can also bring an improvement similar to threshold extension, as described in this column for November 1978.

Direct measurement of carrier-to-noise ratio (**actually carrier-plus-noise to noise**) can be made at the terminal, but is open to several sources of error. Ideally, the uplink carrier should have its modulation removed for the test, and carrier power adjusted to **exclude** any 'back-off' incorporated to reduce intermodulation distortion where multiple carriers are handled (such back-offs are not included in published EIRP footprints — **saturated** transponder power is assumed.) The **noise bandwidth** of the receiver must be accurately known if the measurement is to be meaningful, and care taken in its execution — if using a fixed-tuned receiver and power meter the reading must be taken with the receiver in a **linear** mode, i.e. before any stages of limiting and with any **AGC disconnected**. In directing the antenna off the satellite to measure noise, it is best moved in **elevation**, away from the geostationary orbit and other satellites, and **upward**, away from ground noise. Four degrees of arc should be sufficient movement to take the satellite's signals out of the antenna beam. If a spectrum analyzer is used for the measurement, due regard should be paid to the difference between resolution bandwidth and noise bandwidth (the latter being typically 1.2 times the former), and the non-linear effect of the analyzer's logarithmic amplifier/detector on the displayed amplitude of noise. The first of these effects increases the **displayed** noise amplitude by 0.8 dB, and the second reduces it by 2.5 dB, so

a total **1.7 dB negative correction** has to be applied to the carrier-plus-noise to noise figure read from the display. To obtain a figure for **carrier/noise density** (Ref. CATJ October 1978, p.47), the analyzer measurement should be corrected by the value of the analyzer's resolution bandwidth, expressed in dB Hz, less this 1.7 dB correction factor. So if bandwidth is 10 kHz (40 dB Hz), carrier/noise density is given by

$$\begin{aligned} C/Kt &= 40 \text{ dB} - 1.7 \text{ dB} + (C/N) \\ &\quad (\text{from display}) \\ &= 38.3 \text{ dB} + (C/N) \end{aligned}$$

Incidentally, carrier/noise ratio meters fitted in receivers are notoriously inaccurate, being essentially a **signal level** indication. Their C/N reading is dependent on calibration against an installation measurement.

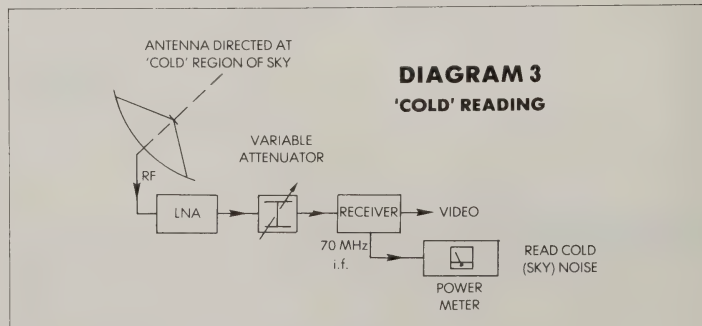
But while carrier-to-noise ratio will tell us if something is **not quite right**, it cannot reveal just where the problem is. Is the LNA falling short of its spec., is satellite EIRP below published

footprint level, is the antenna noise temperature or feed horn pattern incorrect? Could unforeseen terrestrial interference be degrading the performance? We shall examine methods of determining RF performance with reasonable accuracy using **only a calibrated attenuator and VHF signal level meter** or power meter, or in fact with just the meter.

Earth and Sky As Hot and Cold Loads

It is possible to perform a version of the test lab's hot-and-cold noise source test on a fully-equipped terminal in the field, by taking advantage of the fact that the **sky**, away from the ground, the sun, the geostationary orbit and the galactic plane, looks like a radiator of **very low noise temperature**, only a few degrees K, and that the **ground**, or indeed any object that is neither a **perfect conductor** (reflector of RF) or a **perfect dielectric** (transparent to RF), looks like a radiator at **ambient temperature**, being in the neighborhood of **290°K**. So long as our antenna has sufficient gain to ensure that its beam sees effectively **only the ground**, or **only the cold** region of sky, the ratio of the noise levels measured in the receiver under the two conditions can lead us to compute, using the same 'Y-factor' method as in the lab., the excess noise temperature of the system — **essentially that of the LNA**.

We must first connect our power measuring device into the receiver. The 70 MHz i.f. amplifier is the obvious point to measure noise power, before the amplitude limiting of the FM demodulator. Again we must be careful to ensure linearity to the measuring point. AGC must be switched off or disconnected. If MGC is available in the receiver, it should be used to **reduce the gain by some 10 dB from normal**, sufficient to clear any gain compression which might be occurring, even before the limiting stages proper. An RF power meter (HP 435 or similar) is the best way to measure noise power at i.f., but a signal level meter, tunable to 70 MHz, is a satisfactory alternative. Of course, in converting a microvolts or millivolts figure to a ratio expressed in dB, it should be remembered that

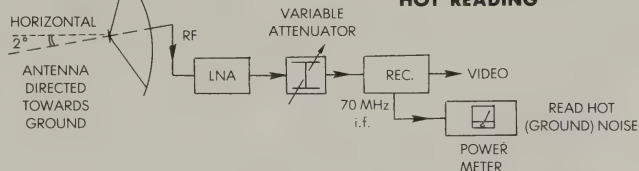


subsequent reference here is to **power ratio**, not voltage. Better still, if a calibrated RF attenuator is available, this can be inserted in circuit and merely used to reduce the 'ground' reading back to the **same value** as the 'sky' reading, the required ratio being the **number of dB change** on the attenuator. This eliminates any receiver and meter nonlinearities from the calculation. The attenuator would preferably be a microwave type, **good to 4 GHz**, 50 ohm impedance, inserted between LNA and receiver, or failing that a 75-ohm type at the head of the receiver's i.f. amplifier. When performing the test, it is worthwhile checking that with the LNA **de-powered**, or replaced by a **matched termination**, receiver noise falls by **at least 10 dB** from the 'sky' value, otherwise the **system noise temperature is not dependent principally on LNA noise**, and checks should then be made on feed-line loss and receiver noise figure.

To measure noise in the 'cold' or 'sky' condition (I shall here refer to the **antenna noise temperature** looking at the cold sky as T_A , and that looking at the hot ground as T_G), we must find a **part of the sky that is cold**. My own preference is to point the antenna toward **Polaris, the North Star**, as this is (in my latitude) well elevated above ground, also it is remote from the direction of the sun, the geostationary orbit, and the powerful galactic and

extra-galactic noise sources (radio stars). Many TVRO antenna mounts do not have sufficient adjustment range to achieve this, so the best we can do is to increase the antenna elevation **above the satellite orbit**, ensuring the sun is at **least 20 degrees off beam** (observe feed shadow on dish surface) and 'rocking' it about this position while observing the noise meter, to check **no other noise source** has entered the antenna beam. It is also wise to perform the test on a **clear day**, as thick cloud, rain, or snow, can themselves act as noise sources and increase the **sky temperature**. Having satisfied ourselves that no stray signals are entering the antenna, we take the power meter reading (or attenuator setting) proportional to T_A , the **antenna noise temperature**.

**DIAGRAM 4
'HOT' READING**



We must now re-orientate to point the beam at the **ground**, or alternatively at any large building or hill subtending a sufficiently large angle at the antenna to **completely fill the beam**. Our chosen 'hot body' should not be too close (say 10 metres) to the antenna, to avoid problems due to change of matching at the LNA input flange. An adequate ground noise measurement should be achieved if the antenna is tilted some **2 to 5 degrees below horizontal**, on level ground. The meter reading (or attenuator setting) then taken is proportional to T_G , the **ground temperature**.

Now, if we can assume sky temperature to be so low as to approach absolute zero, and ground temperature to be a known and measurable value (close to 290°K), we

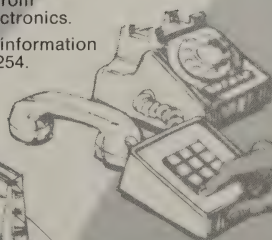
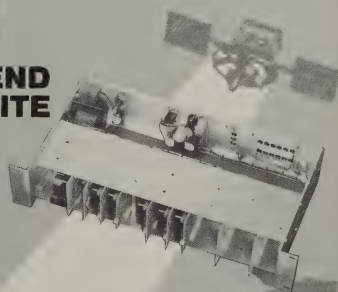
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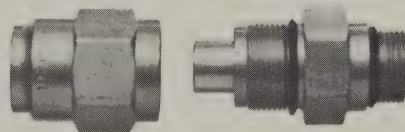
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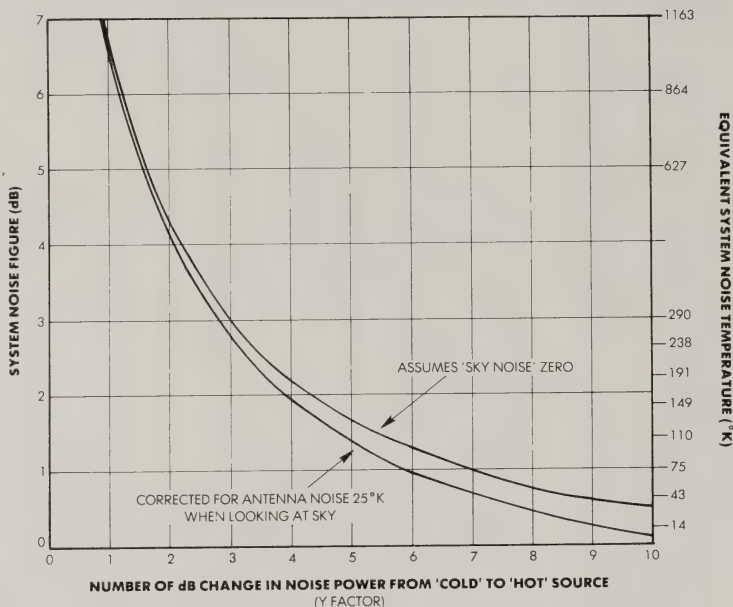
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DIAGRAM 5
CONVERSION OF RECEIVER NOISE POWER
CHANGE TO NOISE FIGURE AND NOISE TEMPERATURE



can calculate from the ratio of our noise power readings, or the difference in attenuator settings for the same meter reading, the excess noise temperature of our LNA-receiver combination. If the 'LNA off' test detailed above is satisfactory, this will equal for all practical purposes the noise temperature of the LNA itself.

Calculation of LNA noise figure and noise temperature...

Let us call the **power ratio** measured in the above test, Y . Measured noise, looking at sky, is proportional to T_R (receiver, i.e. LNA, noise) plus T_A (antenna noise, including T_S , sky noise). We have assumed here that T_S is zero, and for the present shall assume that T_A is also zero. So our 'sky' measurement yields a figure representing T_R . Measured noise, looking at ground, is proportional to $T_R + T_G$, the LNA noise plus the antenna noise with the ground in the beam.

$$\text{Thus our ratio, } Y = \frac{T_R + T_G}{T_R} = 1 + \frac{290}{T_R}$$

$$\text{Thus } T_R = \frac{290}{Y-1}$$

Now noise figure is defined as (in dB)

$$F = 10 \log \left(\frac{T_R + 1}{290} \right)$$

$$\text{So } F = 10 \log \left(\frac{1 + 1}{Y-1} \right) = 10 \log \left(\frac{Y}{Y-1} \right)$$

This formula is valid when T_G is close to the noise figure reference temperature, 290°K, and when T_A can be considered negligible. The upper trace of diagram 5 is a plot of this formula, with both scales expressed in dB. The noise figure and noise temperature corresponding to the measured value of noise power ratio, in dB, can be read off the vertical scale.

In practice, even if sky noise can be neglected, our antenna noise T_A has a value dependent on the antenna design, corresponding to the extent to which minor lobes in its pattern respond to ground noise. This itself is a function of **elevation angle**, and will be specified by the manufacturer over a range of elevation angles. In general the higher the antenna gain, the lower will be its noise temperature, except in certain designs where improved pattern 'cleanliness' is achieved at the expense of some gain. Horn antennas have considerably cleaner polar diagrams than do dishes. The effect of antenna noise will be to reduce the value of our measured Y factor, resulting in an unduly pessimistic estimate of LNA noise performance. Considering that a TVRO antenna at a high elevation (for our 'sky'

measurement) will rarely have a T_A in excess of 25°K and usually less, a second curve has been plotted on diagram 5, incorporating correction for 25°K antenna temperature. The correct value for most terminals will lie between the two curves, perhaps closer to, but not above, the upper one. So this test can establish, with reasonable accuracy, a maximum value for our LNA noise temperature, though the LNA may actually be a few degrees better than the test suggests.

It is of interest that this method tests noise performance **without reference to antenna gain** — as long as there is sufficient gain to see **only** the cold sky or **only** the hot ground (which applies to any antenna suitable for TVRO use), the gain figure does not enter the equations. Similarly, there is no frequency or bandwidth dependence — noise is measured in whatever channel the receiver has selected, and in taking the ratio of powers, bandwidth is cancelled out.

Development Lab application of this method for noise temperature measurement—

If the construction and performance optimization of RF equipment (amplifiers, converters, receivers) is to be attempted, equipment will be required for continuous display of noise



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It stands to reason that if you could offer Multi-Pay (a choice of two or more) services to each home passed, you'd have a much better chance of selling one or more of the services for a substantial increase in penetration of homes passed.

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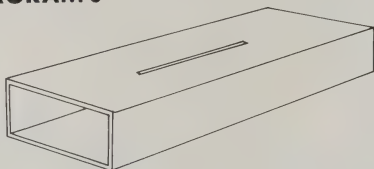
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DIAGRAM 6



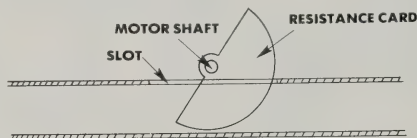
**SECTION OF WAVEGUIDE WR229
WITH SLOT FOR ATTENUATOR**

capable of measuring the very low (around 1 dB) noise figures of satcom LNAs.

There is no problem in achieving a matched load at **room temperature** to act as a **hot load**—a piece of resistance card inserted in waveguide will do very well—but to achieve a **cold load** at a known temperature without cryogenic techniques is not so easy. An extension of the method described, using the cold sky, is a possibility.

It is important that our cold load be a good match to the waveguide—**anything resulting in poor VSWR will also degrade the noise temperature.** This requirement, together with a suitable low antenna temperature, can be satisfied by use of a **horn antenna.**

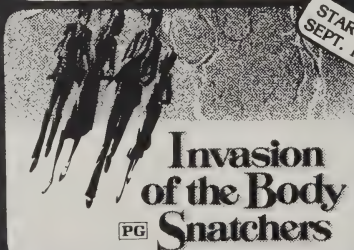
temperature, if not continuous absolute measurement. In view of the **inconvenience** of the standard hot/cold load method (not to mention the cost) alternatives might be sought. Surplus or second-hand noise measuring sets are available quite cheaply, but are usually of the **gas-discharge tube** or solid-state noise generator variety, using the **excess noise** of the source (typically 15.28 dB) when 'on' as the **hot load**, and **room temperature** (source 'off') as the **cold load.** While these are perfectly adequate for terrestrial-performance radios with noise figures from perhaps 6 to 20 dB, they are not



**CROSS-SECTION OF WAVEGUIDE SHOWING
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DIAGRAM 7

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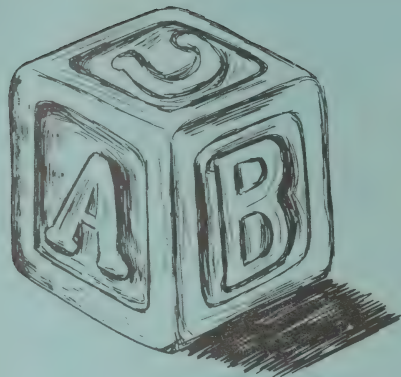
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The 'Gain Block' was developed in the CATJ Lab as a versatile kit project. No tuned circuits (very high quality Hewlett Packard 30 dB gain gold IC/hybrid on sapphire substrate); no tuning, coils or adjustments! Gain extends below 30 MHz (25 dBg at 10 MHz) and up to 450 MHz (still 25 dBg).

All parts are supplied. The housing, regulated power supply (with output jacks to provide a bench-convenient emergency 15 VDC source), the special double-sided etched and drilled circuit board, all controls and components. **PLUS** - a handy manual that illustrates construction plus application of this handy amplifier.

- **No-tuned-circuits** in the 30 dB "Gain Block" kit. Very high quality Hewlett Packard gold IC/hybrid device on sapphire substrate. We guarantee 30 dB gain from 30 to 300 MHz (+ / - 0.5 dB) with no tuning, coils, or capacitors!
- **Extremely linear** with +50 dBmV output capability at -57 dB cross mod for 12 channel (flat) input!
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THE PRICE is \$105 but only as long as our initial supply of "good-buy" HP gold plate hybrid IC's lasts. When the initial stock is gone, the price of the "Gain Block" goes up to \$145. So catch us early while this special introductory price is still good!

TVRO DEMOD KIT. . . this amazing phase lock loop video demodulator kit was developed by CATJ's Steve Birkill and first explained in the October 1978 issue of CATJ. This is the video demodulator that takes a very weak 70 MHz IF signal and turns it into a television picture with a minimum of effort. **PLUS** — it is probably the most sensitive video demodulator circuit available when you deal with below threshold TVRO signals. This is not recommended for big commercial installations, but for people who want to learn more about TVRO reception techniques this will fill the bill. **Price per kit** is \$32. postpaid in USA and Canada.

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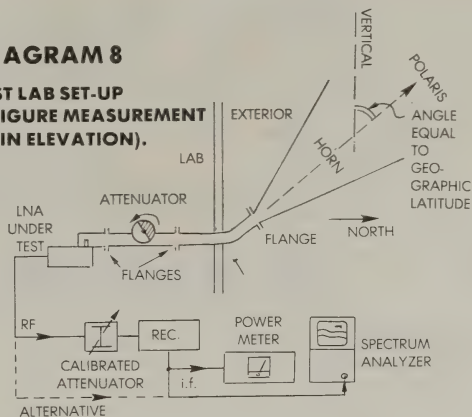
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73107

Kit
Korner

Provided the flare angle is small enough, the horn will provide a **good match and a very clean radiation pattern**. If we construct a horn of sufficient gain, and point it at a quite part of the sky, coupling it to our test item via a short waveguide run, we should be able to achieve a matched load of noise temperature **less than 10°K**—not exactly a reference standard, but quite good enough for optimizing 100°K LNAs. We would just have to appreciate its limitations under overcast conditions!

A convenient way to **switch** from cold to hot load conditions is now to **insert a resistance card attenuator** into the waveguide from the cold load. This being at room temperature will provide a good approximation to the required 290°K source. The attenuator is inserted through a longitudinal slot in the centre of the broad face of the waveguide—here the slot does not interrupt current flow and so has no effect on propagation in the guide. To enable a continuous display of noise performance, insertion and withdrawal of the attenuator can be motorized. Diagram 7 shows a possible arrangement, whereby the resistance card is cut to semi-circular shape and fixed to the shaft of a small motor. Suitable differential amplification could be provided in the receiver by switching the i.f. or noise detector output in synchronism with the motor, to meter noise figure directly. Or more simply, a **spectrum analyzer** display would write **two traces** of noise level, the dB difference between them being the **Y factor** for application to diagram 5. Suitable resistance card would be 0.02

DIAGRAM 8
TEST LAB SET-UP
FOR NOISE FIGURE MEASUREMENT
(VIEW IN ELEVATION).



inches thick, 200 ohms per square. An adequate substitute could be made by dipping card in colloidal graphite, or rubbing a very soft pencil thickly over both sides.

The **horn antenna** for low noise should have at least 25 dB gain—30 dB would be a better figure to aim for. A **2ft square** aperture pyramidal horn, tapering to a WR229 waveguide flange over a **length of at least 4 ft**, would satisfy the requirement. If this is constructed with care to the smoothness and conductivity of all joints (copper or brass construction, all joints

soldered with the **minimum quantity of solder** inside the horn, would be ideal, but sheet aluminum could be made to work as well), and aimed towards the north sky, a noise temperature less than 25°K may be realized. The aperture should of course be covered when not in use, for weather protection—**any corrosion inside horn or waveguide will soon push up the noise level**.

Next month's column will look at a method of measuring G/T directly using solar radiation.

Letters To The Editor...

On behalf of the entire Showtime staff, I would like to express my appreciation for a well planned and well executed CATA convention.

We were very much impressed by the scheduling of events which, we feel, offered an excellent mix of trade show activities, seminars, and socializing.

The meetings were most fruitful for us, and we are already looking forward to Aspen next year.

Sincerely,
Horace M. Spaulding
Vice President
Sales & Marketing Development
SHOWTIME

It was good to visit with you up at CCOS. I only wish we could have spent more time together.

I really believe that a new relationship has developed between CATA and NCTA. A new feeling of cooperation

and teamwork has surfaced and it's a welcome change from what has gone before. We have many more goals in common than not and working for those common ends can be only beneficial for both of us.

Please let me know what I can do to further this growing spirit of cooperation.

Very Truly Yours,
Thomas E. Wheeler
President
N.C.T.A.

"It seems that CATJ has turned into a satellite **hobby magazine** rather than a **journal** for CATV. Earth Stations are still just a part of our industry and there are still a lot of **other** aspects of our business that need covering. I for one would appreciate a return to broader

series of articles that CATJ had before the saturation of satellite articles began."

Excerpt from CATJ Reader Survey

This has been a common complaint and one that indeed the editorial staff has fully recognized. As you say, Earth Stations are one part of our industry, and we will continue to run monthly segments dealing with them. However, you will see a return to the basic nuts and bolts type material upon which CATJ was founded, keeping in mind the construction and rebuilding of cable systems, in addition to areas of management that is pertinent to the efficient operation of a cable system. We think the readers will be pleased with the information that is planned for future issues, and we certainly appreciate your comments, as well as the suggestions you made for Product Reviews and different series.

Ray Daly on Computers In Cable

Ray Daly, President
Computer Cabling, Inc.
2617 42nd St. NW
Washington, D.C. 20007

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We apologize for the omitted two lines in the program and we appreciate the readers who called to mention errors in the Coordinate Distance Calculation printed in the July issue of CATJ. To assist in correcting our information, we are reprinting this program in the correct form with the hope that the omission of two lines did not create major havoc.

Ray Daly's column for October will concern the TRS-80 Model II (not to be confused with Level II), which is a floppy disk based system. CATJ knows that Mr. Daly's loyal readers will look forward to this material in the upcoming issue.

```

100 REM This program will compute distance and azimuth
110 REM Given longitude and latitude of two points
120 REM Formatted for TRS-80 16K Level II
130 REM LEW STROCK — ANTIETAM CABLE TELEVISION
140 REM HAGERSTOWN, MARYLAND
150 REM UPDATE : FORMAT AND DISPLAY 02/24/79
160 REM
170 REM DIMENSION STRINGS AND DEFINE DOUBLE
    PRECISION
180 DIM A$(100), B$(100)
190 DEFDBL A-L
200 REM CLEAR SCREEN AND GET XMTR SITE NAME
    AND LOCATION
210 CLS : PRINT TAB(15) "DISTANCE / AZIMUTH":
    PRINT
220 INPUT "TRANSMITTER LOCATION ";A$
230 REM CONVERT DEGREES-MINUTES-SECONDS TO
    ONE NUMBER
240 INPUT "TRANSMITTER LATITUDE — D,M,S"; D,M,S
250 L1 = D + (M + (S/60)) / 60
260 INPUT "TRANSMITTER LONGITUDE — D,M,S"; D,M,S
270 L2 = D + (M + (S/60)) / 60
280 REM GET RCVR SITE NAME AND LOCATION
290 PRINT
300 INPUT "RECEIVER LOCATION ";B$
310 INPUT "RECEIVER LATITUDE — D,M,S"; D,M,S
320 L3 = D + (M + (S/60)) / 60
330 INPUT "RECEIVER LONGITUDE — D,M,S"; D,M,S
340 L4 = D + (M + (S/60)) / 60
350 REM FIND ANGLES A-B-C AND CONVERT TO RADIANS
360 A = L2 - L4 : A = A * .0174532925
370 B = 90 - L1 : B = B * .0174532925
380 C = 90 - L3 : C = C * .0174532925
390 REM COMPUTE DISTANCE AND AZIMUTH USING TRIG
400 E = COS(B) * COS(C) + SIN(B) * SIN(C) * COS(A)
410 F = ATN (SQR (ABS (1-E ^ 2))) / E
420 G = (COS(C) - COS(F) * COS(B)) / (SIN(F) * SIN(B))
430 H = ATN (SQR (ABS (1-G ^ 2))) / G
440 REM CONVERT H BACK TO DEGREES
450 H = H * 57.2957795785523
460 IF H >= 0 THEN 490
470 H = H + 180
480 REM CONVERT F BACK TO DEGREES
490 F = F * 57.2957795785523
500 REM FIND DISTANCE BY KNOWN DISTANCE SCALE
    OF CO-ORD
510 I = F * 69.05
520 J = SIN(A)
530 REM CONVERT J BACK TO DEGREES
540 J = J * 57.2957795785523
550 REM DISPLAY RESULTS OF COMPUTATIONS
560 PRINT : PRINT A$ "TO"; B$ : PRINT
570 PRINT "DISTANCE = "; USING "###.###"; I; : PRINT "
    MILES";
580 IF J > 0 THEN 600
590 H = 360 - H
600 PRINT " ";
610 PRINT "AZIMUTH = "; USING "###.###"; H; : PRINT "
    DEGREES"
620 PRINT
630 REM GO BACK TO GET OTHER POINTS SERVED BY
    XMTR
640 REM OR START OVER WITH A NEW XMTR SITE
650 Q$ = " " : RESET Q$
660 INPUT "ENTER AN X TO CONTINUE USING THE SAME
    XMTR SITE"; Q$
670 IF Q$ = "X" THEN PRINT @ 320; : PRINT CHR$(31) :
    GOTO 300
680 GOTO 200
690 END

```

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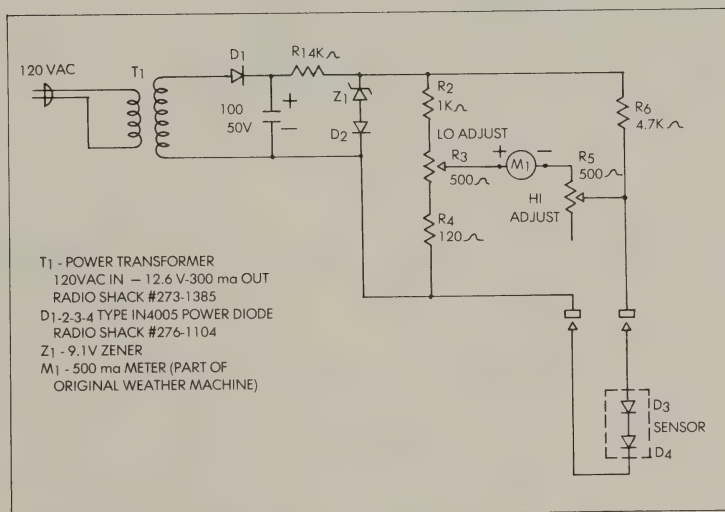
TECHNICAL TOPICS

HUGHES AML SEMINAR SET FOR OCTOBER

Hughes Aircraft Company's microwave communications products has scheduled the next technical seminar on its AML local distribution microwave equipment for the third week in October.

The seminars are held by Hughes to demonstrate detailed operation and maintenance procedures for AML systems to technical personnel from CATV systems throughout the country. The AML multi-channel transmission technique is now used by several hundred CATV systems throughout the United States, Canada and Europe.

The tuition-free seminar will be held October 15 through 19, at Hughes' Torrance, Calif., facility. Registrations will be accepted by contacting Seminar Registrar, Hughes Microwave Communications Products, P.O. Box 2999, Torrance, Calif. 90509, phone (213) 534-2146.

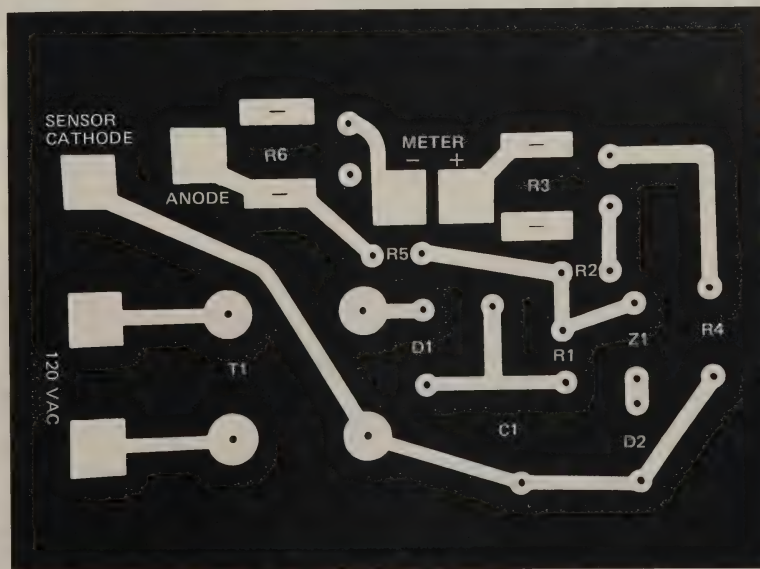


TEMPERATURE MEASURING EQUIPMENT

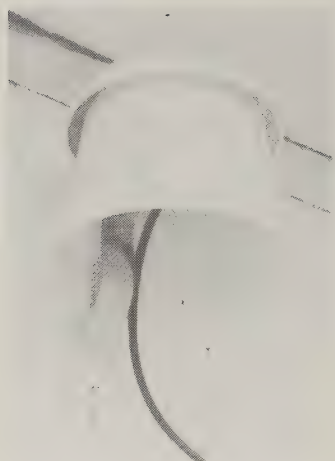
If you are the proud owner of one of the analog weather machines, the type with the dials and TV camera, you may have had the same unhappy experience as many others; that is keeping some of the instruments working.

Lightning appears to be the main culprit in most cases and the temperature measuring equipment seems to be the most vulnerable. This is particularly true in light of the fact that the sensor is generally mounted part-way up the tower. The temperature indicator, along with the associated circuit that is supplied by the manufacturer is by no means of poor quality or design, on the contrary, the whole system is quite accurate and reliable. However, even with the best equipment one will experience failures now and then.

The main problem seems to involve the longevity of the sensor element itself. Of the seven machines we checked, only one had retained its original sensor. All the others have, over a period of years, been replaced and in some cases several times. Here again failure was generally attributed to lightning damage.



TEMP GUAGE — ACTUAL SIZE PRINTED
CIRCUIT PATTERN
(FOIL SIDE)

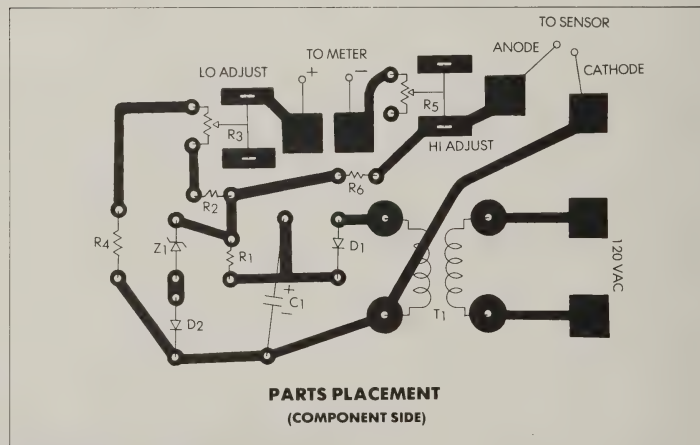
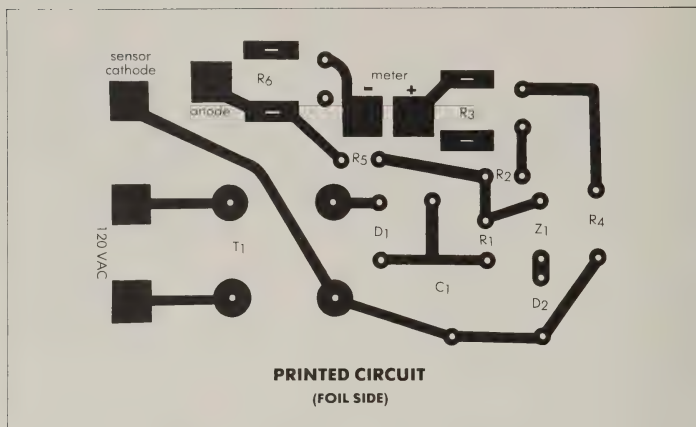


(Temp gauge) sensor flower-pot mounting.

The sensor in these particular units is a thermistor, which, although it is quite accurate, is also very delicate. The obvious answer to the problem is, of course, to come up with a sensor which is a little more rugged.

We've done just that with the following circuit. The sensor utilizes a couple of 1 amp, 600 volt power diodes which are capable of withstanding the rugged environment a little better than the thermistor. The circuit also features good accuracy and ease of calibration and was designed to be fabricated with readily available parts. The only piece of the original equipment you will need is the temperature indicator itself. Most of these indicators use a meter movement which has a sensitivity of 500 ua and our circuit was designed around such a meter.

The circuit, shown in the figure makes use of the negative temperature co-efficient exhibited by the P-N junction of the power diodes. That is, when the temperature of the junction increases its resistance decreases. Two diodes were used to double the overall



resistance of the unit. The diodes make up one leg of a bridge circuit. The meter is placed between the midpoints of the bridge and any change in the resistance of the sensor unbalance the circuit, thereby changing the current

thru the meter.

Two potentiometers are included to facilitate calibration, one for the high end (around 100°) and one for the low end (around 35°).

There is nothing critical about parts

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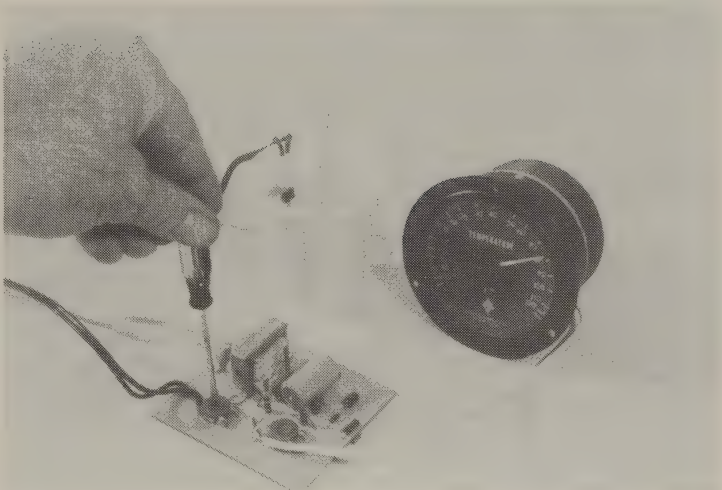
placement. Construction may be point to point, bread board or you may wish to use the P.C. board approach. The lay-out shown in the figure on page 43 is full size and may be used as a guide or reproduced photographically.

The sensor is mounted on a 2-lug terminal strip and coated with a liberal amount of silicone sealer. Before calibration the type or length of wire going to the sensor is not critical, in our test unit we used about 30 feet of RG-59. After you have calibrated the circuit, however, you can't change this wire because it's resistance has become a part of the overall circuit.

To calibrate the unit you will have to have a thermometer which can be emersed in water. An inexpensive photographic thermometer will do fine. The sensor, along with the thermometer is first placed in a cup of ice water and the low pot is adjusted so that the meter reading matches that of the thermometer. The same procedure is then followed with a cup of water at about 100° and the high pot is adjusted. You will have to go back and forth between the two adjustments several times as one will affect the other. Be sure to allow sufficient time for the sensor to react before making each adjustment. After calibration is completed the unit is ready for mounting.

The sensor, which is mounted outside, must be protected from rain and the direct sunshine. In the model we built, this was accomplished by mounting the 2-lug terminal strip in an inverted, light colored, plastic flower pot. Then the whole unit was mounted under the eave on the north side of the head-end building. The circuit board itself fits nicely on the shelf behind the temperature guage in the weather machine.

Our test unit, since installation, has survived a number of severe lightning



Temp guage adjustment.

storms without damage. The over-all linearity and accuracy of the unit is quite good, in fact the reading stays

within a couple of degrees of the two bank thermometers within sight of our office.

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ROSTER

AmeriCom Satellite Network, Inc., (A.S.N.), 310-14th Ave. South, St. Petersburg, FL 33701 **(S4)** 813-895-4201

Anixter-Pruzan, Inc., P.O. Box 88758, Tukwila Branch, Seattle, WA 98188 **(D1)** 206-251-6760

Applied Data Research, Inc., Route 206 Center CN-8, Princeton, NJ 08540 **(M9)** 609-921-8550

Avantek, Inc., 3175 Bowers Avenue, Santa Clara, CA 95051 **(M8)** 408-249-0700

Bankers Trust Company, 280 Park Ave., New York, N.Y. 10017 **(S3, S9)** 212-692-2430

Belden Corp., Electronic Division, P.O. Box 1327, Richmond, IN 47374 **(M3)** 317-966-6661

B.E.I. (BESTON ELECTRONICS, INC.), P.O. Box 106A, Olathe, KS 66061 **(M9 Character Generators)** 913-764-1900

Bestvision Home Cinema, Inc., 5540 W. Glendale Ave., Suite C-106, Glendale, Az. 85301 **(S9 Pay-TV programming and marketing)** 602-931-9157

Bethlehem Tower Works, P.O. Box #68, Harrison, Ark. 72601 **(M9)** 501-741-9031

BLONDER-TONGUE LABORATORIES, One Jake Brown Rd., Old Bridge, N.J. 08857 **(M1, M2, M4, M5, M6, M7)** 201-679-4000

BROADBAND ENGINEERING, INC., 1525 Cypress Dr., Jupiter, FL 33458 **(D9, replacement parts)** 1-800-327-6690

Budco, Incorporated, P.O. Box 4593, Tulsa, OK 74120 **(D9 Security & Identification devices)** 918-584-1115

Cable TV Supply Company, 11505 West Jefferson Blvd., Culver City, CA 90230 **(D1, D2, D3, D4, D5, D6, D7, D8, M5, M6)** 213-390-8002

CCS HATFIELD/CATV DIV., 5707 W. Buckeye Rd., Phoenix, AZ. 85063 **(M3)** 201-272-3850

C-COR ELECTRONICS, Inc., 60 Decibel Rd., State College, PA 16801 **(M1, M4, M5, S1, S2, S8)** 814-238-2461

Century III Electronics, Inc., 3880 E. Eagle Drive, Anaheim, CA 92807 **(M1, M3, M4, M5, M7, M8, S1, S2, S8)** 630-3714

Cerro Communication Products, Halls Mill Rd., Freehold, N.J. 07728 **(M1, M3, M4, M5)** 201-462-8700

Channel Master, Div. of Avnet, Inc., Ellenville, N.Y. 12428 **(M2, 3, 4, 5, 6, 7)** 914-647-5000

COLLINS COMMERCIAL TELECOMMUNICATIONS, MP-402-101, Dallas, TX 75207 **(M9, Microwave)** 214-690-5954

COMM/SCOPE COMPANY, Rt. 1, Box 199A, Catawba, NC 28609 **(M3)** 704-241-3142

COMMUNICATIONS EQUITY ASSOCIATES, 651 Lincoln Center, 5401 W. Kennedy Blvd., Tampa, FL 33609 **(S3)** 813-877-8844

Compucon, P.O. Box 401229, Dallas, Tx. 75240 **(S8)** 214-233-4380

COMPUTER VIDEO SYSTEMS, INC., Suite E, 6290 McDonough D., Norcross, GA 30093 **(M9)** 404-449-3800

Comsearch, Inc., 2936 Chain Bridge Rd., Oakton, VA 22124 **(S8, S9 earth station placement frequency coordination)** 703-281-5550

ComSonic, Inc., P.O. Box 1106, Harrisonburg, VA 22801 **(M8, M9, S8, S9)** 703-434-5965

Comtech Data Corporation, 15207 N. 75th, Scottsdale, AZ 85260, **(M2, M6)** 602-991-9580

Continental Lift Corp., RR 2, Box 9, Austin, Minn. 55912 507-433-7387

CRC ELECTRONICS, INC., 2669 Kilihau St., Honolulu, HI 96819 **(M9 Videotape Automation Equipment)** 808-668-1227

CWY Electronics, 405 N. Earl Ave., Lafayette, Ind. 47904 **(M9, D1)** 317-447-4617

Custom Building Products, Inc., P.O. Box 32231, Okla. City, OK 73132, **(S9, Underground Boring Equip.)** 405-495-1935

Daniels & Associates, 2930 E. 3rd Ave., Denver, Colo. 80206 **(S3, S9 Brokerage)** 303-321-7550

DAVCO, INC., P.O. Box 861, Batesville, AR 72501 **(D1, S1, S2, S8)** 501-793-3816

DF Countryman Co., 1821 University Ave., St. Paul, MN 55104 **(D1, S1, S8)** 612-645-9153

Durnell Engineering, Inc., Hwy. 4 So., Emmetsburg, Iowa 50536, **(M9)** 712-852-2611

EAGLE COM-TRONICS, INC., P.O. Box 93, Phoenix, NY 13135 **(M9 Pay TV Delivery Systems & Products)** 315-695-5406

EALES COMM. & ANTENNA SERV., 2904 N.W. 23rd, Oklahoma City, OK 73107 **(D1,2,3,4,5,6,7,S1,2,S7,8)** 405-946-3788

Entertainment and Sports Programming Network, 319 Cooke St., Plainville, CN 06062 **(S9)** 203-747-6847

FARINON ELECTRIC, 1691 Bayport, San Carlos, CA 94070 **(M9, S9)** 415-592-4120

FERGUSON COMMUNICATIONS CORP., P.O. Drawer 871, Henderson, TX 75652 **(S1, S2, S7, S8, S9)** 214-854-2405

Gardiner Communications Corp., 1980 S. Post Oak Rd., Suite 2040, Houston, TX 77056 **(M9 TVRO Packages, S1, S2, S8)** 713-961-7348

General Cable Corp., 1 Woodbridge Center, P.O. Box 700, Woodbridge, N.J. 07095 **(M3)** 201-636-5500

GILBERT ENGINEERING CO., P.O. Box 14149, Phoenix, AZ 85063 **(M7)** 602-272-6871

Harris Satellite Comm. Antenna Operations Division, P.O. Box 1277, Kilgore, TX 75662 **(M2, M9, S2)** 214-984-0555

Heller-Oak Communications Finance Corp., 105 W. Adams St., Chicago, IL 60603 **(S3)** 312-621-7661

HOME BOX OFFICE, INC., 7839 Churchill Way—Suite 133, Box 63, Dallas, TX 75251 **(S4)** 214-387-8557

HUGHES MICROWAVE COMMUNICATIONS PRODUCTS, 3060 W. Lomita Blvd., Torrance, CA 90505 **(M9)** 213-534-2146

IBM Corp., P.O. Box 2150, Atlanta, GA 30301 404-231-6005

Ind. Co. Cable TV Inc., P.O. Box 3799, Batesville, AR 72501 **(D1, S1, S2, S8)** 501-793-5872

JERROLD Electronics Corp., P.O. Box 487, Byberry Rd. & PA Turnpike, Hatboro, PA 19040, **(M1, M2, M4, M5, M6, M7, D3, D8, S1, S2, S3, S8)** 215-674-4800

JERRY CONN ASSOCIATES, INC., P.O. Box 444, Chambersburg, PA 17201 **(D3, D4, D5, D6, D7, D8)** 717-263-8258

SUPER STATION BECOMES WTBS TURNER COMMUNICATIONS COMPLETES IDENTITY CHANGE

A sweeping identity change has been wrapped up for the Atlanta-based

corporation headed by Ted Turner. First, the FCC granted a name change for the licensee of Channel 17, WTCG, from Turner Communications Corporation to Superstation, INC. The

phrase SUPER STATION has been trademarked by Turner and used on the air and in advertising to support the premise that WTCG is 'The' SUPER STATION.

The FCC further granted the Atlanta independent new call letters: WTBS, which will be official August 27, 1979. The 24-hour sports and movie channel will sign off as WTCG at midnight, August 26, and will immediately sign on as WTBS.

For further information contact the Sales Department, WTBS at (404) 875-7317.

ASSOCIATE SHOWCASE

Klungness Electronic Supply, P.O. Box 547, 107 Kent Street, Iron Mountain, MI 49801 **(D1, D8, S2, S8)** 906-774-1755

LARSON ELECTRONICS, 311 S. Locust St., Denton, TX 76201 **(M9 Standby Power)** 817-387-0002

LRC Electronics, Inc., 901 South Ave., Horseheads, N.Y. 14845 **(M7)** 607-739-3844

Magnavox CATV Division, 133 West Seneca St., Manlius, N.Y. 13104 **(M1)** 315-682-9105

MCE CORP., P.O. Box 1341, 2629 N. 24th Dr., Phoenix, Ariz. 85002 **(M4, M9)** 602-271-9181

MetroData Corp., 2150 North 107th, Suite 420, Seattle, Wa. 98133 **(M9)** 206-367-2100

MICRODYNE CORPORATION, P.O. Box 1527, 627 Lofstrand La., Rockville, MD 20850 **(M9 Satellite TV Recs.)** 301-762-8500

MICROWAVE ASSOCIATES, INC., 777 S. Central Expwy., Suite 4-C, Richardson, TX 75080 **(M9 Microwave Radio Systems)** 816-891-8895

Microwave Filter Co., 6743 Kinne St., Box 103, E. Syracuse, N.Y. 10357 **(M5 Bandpass Filters)** 315-437-4529

MID STATE Communication, Inc., P.O. Box 203, Beech Grove, IN 46107 **(M8)** 317-787-9426

Modern Cable Programs Division of Modern Talking Picture Service, Inc., 2323 New Hyde Park Road, New Hyde Park, NY 11042 **(S4)** 516-437-6300

MSI TELEVISION, 4788 South State St., Salt Lake City, UT 84107 **(M9 Digital Video Equip.)** 801-262-8475

National Screen Service Corp., 1600 Broadway, New York, NY 10019 **(M9)** 212-246-5700

NORTHERN CATV DISTRIBUTORS, INC., 8016 Chatham Dr., Manlius, NY 13104 **(D1)** 315-682-2670

OAK INDUSTRIES INC./CATV DIV., Crystal Lake, IL 60014 **(M1, M9 Converters, S3)** 815-459-5000

PRODELIN, INC., 1350 Duane Avenue, Santa Clara, CA 95050 **(M2, M3, M7, S2)** 408-244-4720

Q-BIT Corporation, P.O. Box 2208, Melbourne, FL 32901 **(M4)** 305-727-1838

Reuters, 1212 Avenue of the Americas, 16th Floor, New York, N.Y. 10036 **(D9)** 212-730-2715

RMS CATV Division, 50 Antin Place, Bronx, NY 10462 **(M5, M7)** 212-892-1000

Sadelco, Inc., 299 Park Avenue, Weehawken, NJ 07087 **(M8)** 201-866-0912

SATCO, P.O. Box 1260, Lewisville, TX 75067 **(M4)** 214-436-9509

Scientific Atlanta Inc., 3845 Pleasantdale Rd., Atlanta, GA 30340 **(M1, M2, M4, M8, S1, S2, S3, S8)** 404-449-2000

SCIENTIFIC COMMUNICATIONS, INC., 3425 Kingsley Rd., Garland, TX 75041 **(M4 Low Noise & Parametric)** 214-271-3685

Sherman and Brown Associates, P.O. Box 4475, Ft. Lauderdale, Fla. 33338 **(S3)** 305-561-9334

Showtime Entertainment, Inc., 1211 Ave. of the Americas, New York, NY 10036 **(S4)** 212-575-5175

Southern Satellite Systems, Inc., P.O. Box 45684, Tulsa, OK 74145 **(S9)** 918-664-4812

Systems Wire and Cable, Inc., P.O. Box 21007, Phoenix, AZ 85036 **(M3)** 602-268-8744

Tele-Wire Supply Corp., 122 Cutter Mill Rd., Great Neck, N.Y. 11021 **(D1, 2, 3, 5, 6, 7, 8, 9)** 516-829-8484

T.E.S.T., Inc., 16130 Stagg St., Van Nuys, CA 91409 **(M9 Encoders & Decoders)** 213-989-4535

TEXSCAN Corp., 2446 N. Shadeland Ave., Indianapolis, IN 46219 **(M8 Bandpass Filters)** 317-357-8781

The Associated Press, 50 Rockefeller Plaza, New York, NY 10020 **(S9 Automated News SVC)** 212-262-4014

Theta-Com CATV, Division of Texscan Corporation, 2960 Grand Avenue, Phoenix, AZ 85061, **(M1, M4, M5, M7, M8)** 602-252-5021

TIMES WIRE & CABLE CO., 358 Hall Avenue, Wallingford, CT 06492 **(M3)** 203-265-2361

Tocom, Inc., P.O. Box 47066, Dallas, TX 75247 **(M1, M4, M5, Converters)** 214-438-7691

TOCOM COMMUNICATIONS, INC., 1077 Independence Ave., Mtn. View, CA 94043 **(M4, M5, M9)** 415-969-3042

Toner Cable Equipment, Inc., 969 Horsham Rd., Horsham PA 19044 **(D2, D3, D4, D5, D6, D7)** 800-523-5947, In Penna. 800-492-2512

Trenco Inc., P.O. Box N, 385 South 300 West, Salem, UT 84653 **(S1, S2, S7, S8, S9 Consulting)** 801-798-8633

Triple Crown Electronics Inc., 42 Racine Rd., Rexdale, Ontario, Canada M9W2Z3 **(M4, M8)** 416-743-1481

TURNER COMMUNICATIONS CORP., (WTCH-TV), 1018 West Peachtree St., Atlanta, GA 30309 **(S9)** 404-875-7317

UNITED PRESS INTERNATIONAL, 220 East 42nd St., New York, NY 10017, **(S9 Automated News Svc.)** 212-682-0400

UNITES STATES TOWER & FAB. CO., P.O. Drawer "S", Afton, OK 74331 **(M2, M9)** 918-257-4257

United Video, Inc., 5200 S. Harvard, Suite 4-D, Tulsa, OK 74135 **(S9)** 918-749-8811

Van Ladder, Inc., P.O. 709, Spencer, Iowa 51301 **(M9, Automated Ladder Equipment)** 712-262-5810

VIDEO DATA SYSTEMS, 40 Oser Avenue, Hauppauge, NY 11787 **(M9)** 516-231-4400

VITEK ELECTRONICS, INC., 4 Gladys Court, Edison, NJ 08817 201-287-3200

WAVETEK Indiana, 66 N. First Ave., Beech Grove, IN 46107 **(M8)** 317-783-3221

WEATHERSCAN, Loop 132, Throckmorton Hwy., Olney, TX 76374 **(D9, Sony Equip. Dist., M9 Weather Channel Displays)** 817-564-5688

Western Communication Service, Box 347, San Angelo, TX 76901 **(M2, Towers)** 915-655-6262/653-3363

Winegard Company, 3000 Kirkwood Street, Burlington, Iowa 52601 **(M2, M3, M4, M5, M7)** 319-753-0121

NEW PORTABLE ENG RECEIVER

A new 2 GHz portable ENG Receiver is now available from Microwave Associates Communications. The unit, called the MA-2P, is designed as a companion to both the MA-2CP and the MA-2EP portable microwave Transmitters previously introduced. The MA-2P features frequency agility over 21 channels in the 1990 to 2110 MHz band. Either 12 Vdc or 115/230 Vac source voltages may be used. Selection is made by substituting power cables.

A low noise preamplifier is included as a standard feature and provides a receiver noise figure of 3.5 dB. The user may select either 1 or 2 audio sub-carrier demodulators as well as either a 20 MHz or 12 MHz IF bandwidth for the desired degree of selectivity.

The unit may be used as part of a portable microwave repeater system for special events coverage or as part of an aircraft repeater system.

The MA-2P is housed in a lightweight weather resistant, cast aluminum case.

Plug-in modular construction is used throughout. Front panel metering functions are provided for power supply voltages, local oscillator operation, discriminator and AGC level. Audio output impedance is 600 ohms balanced in three switchable ranges, 0, +9, or +18 dBm.

For further information concerning this news release, contact:
Erik Stromsted
Microwave Associates Communications
Burlington, Massachusetts 01803
(617) 272-3100

TECHNICAL SEMINARS FOR CATV SYSTEM PERSONNEL

Texscan Corporation announces their continuation of the 1979 Technical Training seminars to be held at various locations over the United States. You may want to schedule some of your personnel into one of these seminars close to your location. These seminars have been widely accepted in the past and the learning experience for your people would be invaluable.

These are five day seminars, with three days being lectures and two days of hands-on sessions. Tuition is \$175. per enrollee and includes lunch each day, printed material, and an electronic slide rule calculator (theirs to take home!).

Texscan will have a 30-channel system and a 8-amplifier cascade as part of the equipment, so there will be an opportunity for a wide range of experience and practical application.

Registration is at 8 a.m. on the beginning day and the sessions run each day until 5 p.m.

Dates and locations are as follows:

October 8-12	Dallas, Texas Sheraton Hotel (Jupiter & LBJ Freeway)
November 12-16	Albany, New York Turf Inn
December 3-7	Atlanta, GA. hotel to be announced
January 14-19	Indianapolis, Indiana Sheraton Northeast
February 18-22	Los Angeles area location to be announced
February 25-29	Seattle, WA. hotel to be announced
March	tentative dates for Montreal, Canada

For further information, contact:

Raleigh B. Stelle or Bob Jackson
TEXSCAN Corp.
2446 N. Shadeland Avenue
Indianapolis, IN. 46219
Telephone - 317-357-8781

CLASSY-CAT advertising is handled as a no-charge membership service of and by CATA. The rules are as follows:

- 1) **Any member of CATA** (member-system, Associate member, individual member) qualifies for CLASSY-CAT advertising space free of any charge (limit 50 words/numbers per issue);
- 2) **Member-systems** pay regular dues to CATA on a monthly basis; Associate members pay a one time annual fee; "Individual" members pay a one time annual fee of \$25.00 per year.
- 3) **CLASSY-CAT advertising is also available to non-members** at the following rates: **50 cents per word** with a minimum per insertion of \$20.00. A charge of \$2.00 per insertion is made for blind-box numbers or reply service.
- 4) **Deadlines** are the 15th of each month for the following month's issue.
- 5) **Terms for non-members is full payment with order** (no invoicing).
- 6) **Address all CLASSY-CAT material to:** CLASSY-CAT Advertising, CATV, Suite 106, 4209 NW 23rd Oklahoma City, Ok. 73107.

The Associated Press/Press Association has available Model 5401 Video Generators from Data Technology for black and white roll-up display of AP NewsCable. Adaptable for color and local input. Starting at \$800 plus freight. Contact: Henry Heilbrunn, 212/262-4014.

CATV BROKERS AND CONSULTANTS

SHERMAN and BROWN Associates
1110 Brickell Ave., Suite 430
Miami, Florida 33131
(305) 371-9335

Wanted: used Tocom amplifiers—TRA-240-D & S; also TRA-237 W or wo. cases—write giving condition & price asked. EMCO CATV, INC., Box 646, Manchester, Vt. 05254.

MALARKEY, TAYLOR AND ASSOCIATES VICE PRESIDENT - ENGINEERING

MTA's expansion in engineering oriented projects demands an experienced professional to assist Engineering Senior Vice President, Archer Taylor. This position requires an EE degree, experienced in cable industry, a self-starter and ability to meet and work with people.

Computer experience desirable, but not mandatory.

This position offers an opportunity to join a team of performance oriented individuals, a salary commensurate with qualifications and experience. Excellent fringe benefits.

Send detailed resume and salary requirements in complete confidence to:

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c/o Malarkey, Taylor and Associates
1225 Connecticut Ave. N.W.
Washington, D.C. 20036
(202) 223-2345

FOR SALE:

Two Ameco Modulators, Ch. 8 Aural 4.5 MHz input. \$250.00 each.
Listronics, Inc.
213-957-0618

SATELLITE T.V. ANTENNA POLAR MOUNT.

Detailed plans for polar mount for 10'-12' dishes. "Instant" positioning for any satellite in geostationary arc. Includes suggestions for cost effective private earth terminal construction and how to find used dishes. Only \$10.00 postpaid. Satellite Innovations, P.O. Box 5673, Winston Salem, N.C. 27103.

HELP WANTED

Small MSO needs good construction man able to perform without direct supervision. Duties will include small extensions, some underground, some tower. Some technical knowledge helpful. Good Salary and good benefit package to right person. Send reply and salary history to:

GS Communications, Inc.
P.O. Box 398
Frederick, MD. 21701

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Immediate opening in our Dade County system. New 2-Way, 400-Mile plus system under construction. Responsible for supervising technical staff. Minimum 5 years experience—Heavy in construction and system maintenance. Salary Open. Full Benefits. Send resume to: P.O.B. 160848, Miami, FL. 33116. All replies will be acknowledged and held confidential.

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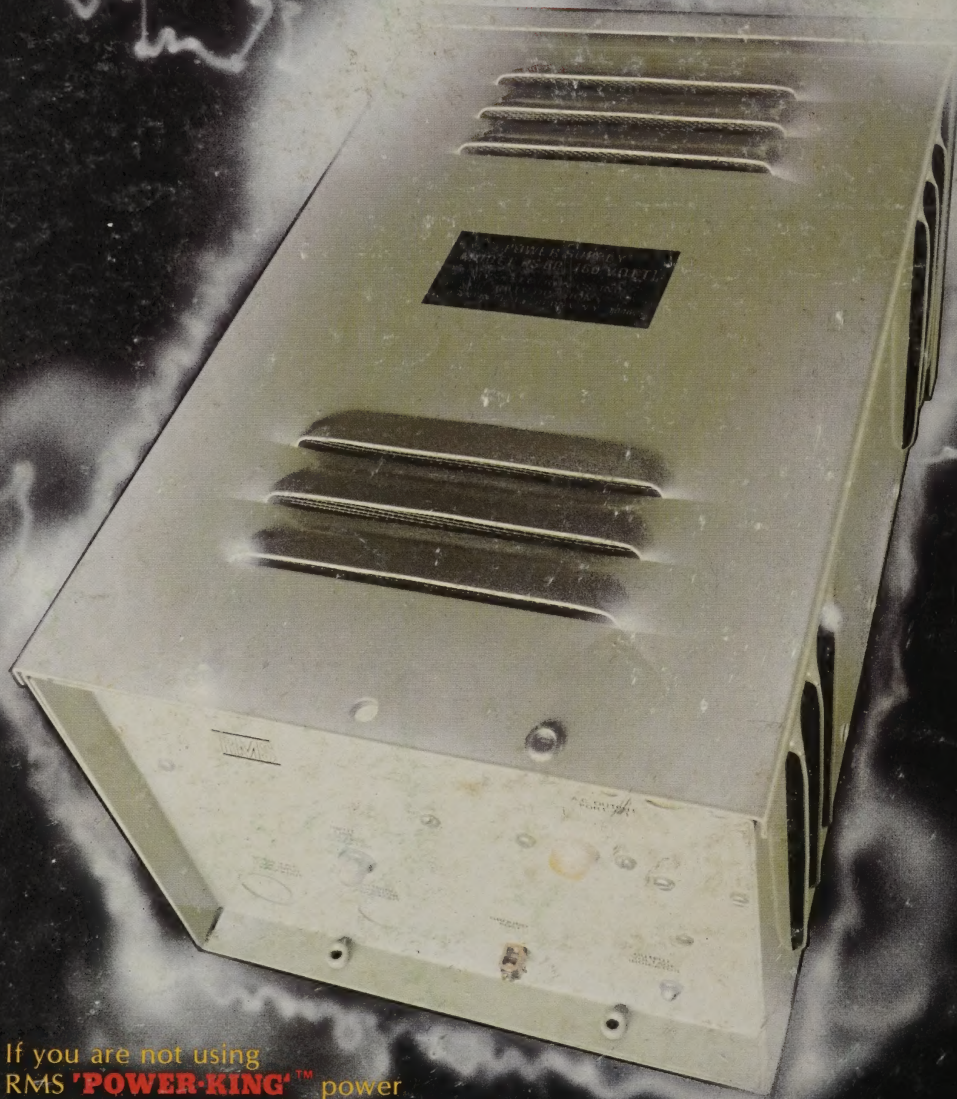
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